

Synopsis of the Grenadier Fishes (Gadiformes; Teleostei) of Taiwan

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Species of grenadier fishes (Order Gadiformes) in Taiwan are reviewed. The species list of Shao et al. (2008) is revised. A total 71 species in 21 genera and 3 families is recognized, including 5 species that are tentatively identified and 5 species, *Coelorinchus hexafasciatus*, *C. cf. macrorhynchus*, *C. cf. notatus*, *Hymenocephalus papyraceus*, and *Ventrifossa sazónovi*, that are first records for Taiwan. *Ventrifossa fusca* is recognized as a junior synonym of *V. misakia*. Keys to families, genera and species are provided. Species descriptions are based mainly on Taiwanese specimens but supplemented with specimens from various other sources. Figures of species firstly reported by Shao et al. (2008) are provided.

KEYWORDS: Pisces, taxonomy, Bathygadidae, Macrouridae, Macrouroididae, Taiwan

Grenadiers constitute the largest group of deepwater demersal fishes found at continental-slope depths between 200 m and 4000 m of all oceans. We here use the common name grenadier to include members of four distinct families—Bathygadidae, Macrouridae, Macrouroididae, and Trachyrincidae—of the order Gadiformes, in which the highly valued codfishes of the family Gadidae are a part. Macrouridae is the largest family in the order with more than 350 species classified into about 30 genera. Grenadiers are almost exclusively benthopelagic in habit, with only a few species having taken up a bathypelagic existence. Pelagic captures of some normally benthopelagic species suggest that individuals may on occasion forage well off the bottom, and these forays may be vertical or offshore movements.

Recent deepwater trawl collections from Taiwanese waters have shown an astonishing diversity of benthopelagic fishes, among which the grenadiers are represented by the highest number of species. Shao et al. (2008) recorded 71 species of grenadiers categorized into 19 genera and three families; 33 of those species (in 10 genera) were newly recorded from Taiwan and were captured only since 2001. Our subsequent re-examination and re-evaluation of specimens have changed the composition of the list slightly, but retained the same number of species (70 if *Coelorinchus productus* is accepted to be a synonym of *C. anatirostris*) classified in 21 genera (2 genera formerly treated as subgenera *Hymenogadus* and *Spicomacrurus*). Shao et al. (2008) analyzed the species composition of the group as related to depth and geography in Taiwanese waters and found a distinct separation at 600 m and 1000 m. The principal factors influencing grenadier species composition in the catches were depth, geographic region, and net type.

Documenting the diversity of Taiwan's continental-slope fauna is highly important at this time because of the recently developed deepwater trawl fishery in the country, which has been exploiting the offshore resources heavily. The primary species targeted in this fishery are the shrimps and prawns, with the more valuable food fishes in the catches hand-selected out at the dockside markets. Whatever bycatch remains, and that includes many species of grenadiers, is ground up to be used as feed stock in the country's extensive aquaculture and poultry industries. It is doubtful that such heavy exploitation of these resources can continue without a dramatic depletion of the stocks, owing to the presumed slow growth rate of most deepwater animals. The classic, well-documented depletion of the deepwater orange roughy *Hoplostethus atlanticus* stocks off New Zealand and Australia is mirrored in the North Atlantic by the stocks of roundnose grenadier *Coryphaenoides rupestris* and roughhead grenadier *Macrourus berglax*, which by some estimates can be considered as threatened in the northwestern part of the Atlantic (Devine et al. 2006; Devine and Haedrich 2008). Merrett and Haedrich (1997) provide detailed case examples as well as an overview of development, history, and future of deepwater demersal fisheries in their highly informative book *Deep-sea demersal fish and fisheries*.

The many species of grenadiers brought into Taiwanese ports and the difficulty in identifying

them have prompted us to develop this identification guide, which we hope will allow its users to accurately identify and document one of the chief components of most deepwater catches. Such identifications are crucial for obtaining accurate statistical information on Taiwan's fishery resources and ultimately to developing regulations that will ensure their sustainability into the distant future, as well as maintaining that part of the rich biodiversity heritage of the country.

MATERIAL AND METHODS

Data herein provided are from the specimens we have examined, mostly from Taiwan and Japan, but sometimes from other areas as indicated in the Materials Examined sections. Specimens are primarily from the Academia Sinica, Research Center for Biodiversity (formerly Institute of Zoology) (ASIZ), with supplemental material from the California Academy of Sciences (CAS), Laboratory of Marine Biology, Faculty of Science, Kochi University, Kochi (BSKU); Hokkaido University Museum, Hakodate, Hokkaido (HUMZ); National Museum of Marine Biology and Aquarium (NMMB-P), Kenteng, Taiwan; National Science Museum, Tokyo (NSMT); and United States National Museum of Natural History, Washington DC (USNM). Methods for making counts and measurements follow Iwamoto (1970) and Iwamoto and Sazonov (1988), and further elaborated on by Iwamoto and Williams (1999). The reader is referred to Eschmeyer's *Catalog of fishes* (1998) for complete references to species and generic names. An updated online version can be accessed at <http://www.calacademy.org>. Institutional abbreviations are taken from Fricke and Eschmeyer (2009).

In the **MATERIAL EXAMINED** sections, the ASIZP specimens are grouped by general locality (abbreviated as in following paragraph) and listed by institutional catalog number followed in parentheses by number of specimens, place name or station number, and size range. Collection data for research vessel stations and fishing ports are provided in Appendix 1 (Table 1). The official and unofficial Taiwanese names of Taiwan fishing ports, in English and Chinese, and the geographic coordinates for each locality can be found in Ebert et al. (2013: table 5, fig. 1).

For non-ASIZP specimens more complete data are provided in these sections. The reader should note that characters used in the keys and diagnoses for genera are often not repeated in the descriptions of the species of the particular genus. The **DISTINGUISHING FEATURES** in the species descriptions are usually only those needed to distinguish Taiwan species from others of the genus and may not apply if used with collections from other areas. Distributions are given in more detail for Taiwan records than for other areas. There was no attempt to make the synonymies comprehensive; they are limited to those most applicable to the Taiwanese fauna. Illustrations have been kept to a minimum because a forthcoming book on the codfishes of Taiwan, geared for a general audience, will be fully illustrated with photographs or line drawing of all Taiwan species.

ABBREVIATIONS. For measurements and counts: TL, total length; PAL, pre-anal length; HL, head length; 1D, first dorsal fin; 2D, second dorsal fin; P, pectoral fin; V, pelvic fin; A, anal fin; GR-I, gill rakers on first arch, GR-II, gill rakers on second arch; pyl. caeca, pyloric caeca. Other: descr., description; fm, fathom[s]; e., east, eastern; local., locality[ies]; n., north, northern; s., south, southern; spec., specimen[s]; sta., station; w, west, western. Abbreviations for localities in Taiwan follow Shao et al. (2008): ET, eastern Taiwan; NET, northeastern Taiwan; SET, southeastern Taiwan; SWT, southwestern Taiwan; SCS, South China Sea.

RESULTS

The Diversity and Current Status of Grenadier Species in Taiwan

In this study, 71 species of grenadiers in 21 genera and 3 families are recognized. Despite a relatively limited coastline (500 nautical miles), the species diversity in Taiwan is very high compared to nearby areas. Of this total, 63 species (of 366, or ca. 17%) are in the family Macrouridae, 7 species (of 27, or ca. 30%) in the family Bathygadidae, and 1 species (of 2) in the family Macrouroididae. The top three largest genera, all in Macrouridae, are *Coelorinchus* (23 species), *Ventrifossa* (9 species) and *Nezumia* (5 species). Six species were described from Taiwan, and three of them (*Coelorinchus leptorhinus*, *C. sheni* and *C. fuscigulus*) have not been reported elsewhere.

Shao et al. (2008) published a list of grenadier species from Taiwan with a discussion of their distribution pattern.

After our detailed examination of specimens from Taiwan and based on new evidence, we have made the following name changes to Shao et al.'s list: (1) specimens of *Gadomus multifilis* are now recognized as *Gadomus* cf. *multifilis*; (2) records of *Coelorinchus cylindricus* in Taiwan have been replaced by *C. fuscigulus* Iwamoto, Ho & Shao, 2009; (3) the specimen of *Coelorinchus spinifer* is now recognized as *C.* cf. *spinifer*; (4) the specimen of *Coryphaenoides asper* is now recognized as *C.* cf. *asper*; (5) *Hymenocephalus gracilis* has been reassigned to *Hymenogadus* and *Hymenocephalus kuronumai* has been reassigned to *Spicomacrurus*; (6) the western Pacific population of *Malacocephalus laevis* is now recognized as *M. nipponensis*; (7) specimens of *Nezumia coheni* are now recognized as *N.* cf. *coheni*; (8) the specimen of *Nezumia loricata* is now reidentified as *N. proxima*; (9) a specimen of *Pseudocetonurus septifer* is now recognized as *P.* cf. *septifer*; (10) the specimen of *Paracetonurus cetonuropsis* is now reidentified as *Pseudonezumia pusilla*; and (11) *Ventrifossa fusca* is now recognized as a junior synonym of *V. misakia*.

We also report as first records for Taiwan *Coelorinchus hexafasciatus*, *C.* cf. *macrorhynchus*, *C.* cf. *notatus*, *Hymenocephalus papyraceus*, and *Ventrifossa sazonomi*. Specimens of six species are provided tentative identifications because they showed certain character differences compared with published descriptions. Further study may result in recognizing them as new species or subspecies. Moreover, several specimens of *Bathygadus* could not be confidently identified and were therefore listed with no names: the genus is in great need of revision.

SYSTEMATICS

Key to the Grenadier Families in Taiwan

- 1a. One dorsal fin, no part elevated; head notably inflated; eyes tiny, horizontal orbit diameter more than 10 times in HL Macrouroididae
- 1b. Two dorsal fins, the first elevated; eyes larger, orbit diameter much less than 10 times in HL 2
- 2a. Second dorsal fin high, much better developed than anal fin; gill rakers long and lathlike; outer gill slit wholly unrestricted. Bathygadidae
- 2b. Second dorsal fin usually much less developed than anal fin; gill rakers short, tubercular; outer gill slit variously restricted by folds of skin connecting gill arch above and below. Macrouridae

Family Bathygadidae

Key to the Genera and Species of Bathygadidae in Taiwan

- 1a. Chin barbel long, greater than half orbit diameter; elongated ray(s) in 1D, P and V; V 8 (rarely 9) 2 (*Gadomus*)
- 1b. Chin barbel usually absent, if present, length much less than half orbit diameter; usually no greatly elongated rays except in V, and if present, ray extremely fine distally and usually less than HL; V 8–10 (rarely 11) 4 (*Bathygadus*)
- 2a. GR-I with blunt tips, 4–6+20–23 3
- 2b. GR-I with pointed tips, 6+22–26 *G. cf. multifilis*
- 3a. Chin barbel about 3 times or less into HL; pyl. caeca 24–29. *G. magnifilis*
- 3b. Chin barbel about 2 times into HL; pyl. caeca 95–134. *G. colletti*
- 4a. Gular membranes scaled; orbit width 1.1–1.2 times into interorbital 5
- 4b. Gular membranes wholly naked; orbit width 1.2–2.1 times into interorbital 6
- 5a. V 10 (rarely 11); barbel rarely present; pyl. caeca 12–19. *B. nipponicus*
- 5b. V 9 (rarely 10); rudimentary barbel usually present; pyl. caeca 34–54. *B. garretti*
- 6a. Head bones weak, skin thin and fragile; interorbital width 31–36% HL; pyl. caeca 10–18.
..... *B. antrodes*
- 6b. Head bones relatively strong, skin usually rather stout and thick; interorbital width 26–30% HL; pyl. caeca 20–22 *B. furvescens*

Genus *Bathygadus* Günther, 1878

DISTINGUISHING FEATURES.— Chin barbel usually absent; when present barbel tiny and difficult to see without magnification. In some species, 1D, P, and V with a relatively elongated ray, but never extremely long and thickened to degree found in *Gadomus* species.

REMARKS.— Identifying some members of this genus has been difficult and uncertain, partly owing to the often poor condition of the specimens. Their delicate bones and integument are easily damaged in trawls, and crucial identification features are often distorted, damaged, or destroyed. The many species described from the broad area encompassing Japan, Taiwan, the South China Sea, Philippines, and Indonesia and our limited knowledge of distributional limits of the species leave the possibility of encountering one or another species wide open. Our study material included a number of specimens for which we could not arrive at a satisfactory identification; such specimens are listed under *Bathygadus* sp. indet. and accompanied by brief remarks.

The genus was reviewed by Howes and Crimmen (1990), but many of their taxonomic conclusions are questionable (see Sazonov 1994:101; Iwamoto and Merrett 1997:479).

Bathygadus antrodes (Jordan and Gilbert, 1904)

Melanobranchnus antrodes Jordan and Gilbert, 1904:606–607, pl. 4, fig. 7. (holotype: USNM 50932, 265 TL, Sagami Bay, Japan, 501–749 fm [916–1,370 m], *Albatross* sta. 3696; other spec. from Sagami and Suruga bays, 480–677 fm [878–1238 m]).

Bathygadus antrodes: Gilbert and Hubbs, 1916:149–150 (16 spec., 9 local. off Honshu I., Japan; 440–712 fm [805–1,302 m]).— Okamura, 1970:30–33, pl. XI, text-fig. 16 (descr.; 15 spec.; Japan); Okamura, 1984:197, 356, fig. 138 (descr. in Japanese and English; 4 spec.; s. Japan, Okinawa Trough, 792–1,200 m).— Howes and Crimmen, 1990:191 (USNM spec.; s. Japan). Sazonov 1994:100–101, fig. 1 (5 spec., Nintoku Seamount [on Emperor Seamounts chain]; 1120–1160 m).— Chiou et al., 2004b:39, fig. 5 (2 spec., NET; one spec. we currently re-identify as *B. garretti*).— Shao et al., 2008: table 2 (19 spec., NET, SWT, SET, SCS).

MATERIAL EXAMINED (7 spec.).— **NET:** ASIZP 61225 (1, 635 TL); Da-xi. **SCS:** ASIZP 65515 (1, 66.8 HL, 350 TL); CD 322, 1098 m; ASIZP 65633 (2, 150–375+ TL); CD 229, 880–1062 m. **SET:** ASIZ 67033 (1, 78.1 HL, 367+ TL); CP 350, 1148 m; ASIZP 66100 (1, 62 HL, 310 TL); CD 322, 1098 m; ASIZP 66110 (1, 73.1 HL, 377+ TL); CD 322, 1098 m.

DISTINGUISHING FEATURES.— A species of *Bathygadus* with no scales on gular membrane; chin barbel absent; dorsal profile behind head elevated, nape somewhat humpbacked; 1D II7–9; P i14–i18; V 8–9; GR 5–6+18–20; pyl. caeca 10–18*; interorbital width 31–36% HL; orbit diameter 18–22%; upper jaw length 53–64%; filamentous rays of 1D, P, and V when intact slightly longer than head.* Head bones and integument notably thin and fragile. Color overall dark; fins, head, abdomen, mouth, and gill cavity usually black. (* indicates data from Gilbert and Hubbs, 1916).

DISTRIBUTION.— From n. part of Japan (Tohoku region of Honshu Is.) s. to Taiwan (NET, SET, SCS) and on Emperor Seamounts Chain (at 40°05'N, 170°43'E), from about 800 to 1370 m.

REMARKS.— Chiou et al. (2004b:39, 42, fig. 5) recorded this species from Taiwan based on two specimens, but we re-identified one of them (ASIZP 61226) as *B. garretti*. *Bathygadus antrodes* is closely similar to *B. bowersi* (Gilbert, 1905) from Hawaii and to *B. spongiceps* Gilbert and Hubbs, 1920 from the Philippines and Indonesia. Characters used to distinguish the three are minimal and need to be further supported. A closer comparison with many more specimens from throughout the western and central Pacific should prove fruitful.

Bathygadus furvescens Alcock, 1894

Figures 1A–B.

Bathygadus furvescens Alcock, 1894:128 (holotype ZSI F13047, “20.5 inches” [ca. 52 cm]; off Maldives, *Investigator* sta. 150; 719 fm [1,315 m]).— Gilbert and Hubbs, 1920:388–391 (descr.; 5 spec., 5 loc., Philippine and Indonesia; 565–976 fm [1033–1785 m]).— Iwamoto and Merrett, 1997:479 (validated position of species in *Bathygadus*).— Iwamoto and Graham, 2001:422–423, fig. 17 (descr., 10 spec., se. coast Australia, “depths between 1,000 and 1,240 m”).— Shao et al., 2008: table 2 (2 spec., SET, first record for Taiwan).

MATERIAL EXAMINED (10 spec.).— **SET:** ASIZP 65510 (1, 91.8 HL, 475+ TL); CP 127, 1263–1268 m. Others questionably assigned to species, but with black head and abdomen, lacking paler areas on head: **SET:** ASIZP 66938 (1, 475 TL); CP 127, 1263–1268 m. **SWT:** ASIZP 66115 (1, 100 HL, 450 TL); CD 322, 1098 m; ASIZP 70215 (1, 345 TL); ASIZP 63788 (4, 118+–380+ TL); CD 192, 1305 m; ASIZP 65530 (2, 280–335 TL); CD 134, 736–1040 m.

DISTINGUISHING FEATURES.— A species of *Bathygadus* with no scales on gular membrane; chin barbel absent; dorsal profile slightly elevated over nape; 1D II,8–10; P i15–i19; V 8–9; gill-rakers outer arch (5–6) + (18–20); pyl. caeca 20–22. Interorbital width 26–30% HL; orbit diameter 21–23%; suborbital width 14–15%; postorbital length 51–55%; distance orbit to preopercle 48–50%; length upper jaw 56–59%; length P 61–81%; length V 67–83%; length longest gill-raker 13–15%. Fins well developed; outer V ray elongated and distally filamentous. Flesh and head bones relatively firm. Fins black to dark dusky. (After Iwamoto and Graham [2001:479] except for lengths of postorbital and longest gill-raker, the ranges of these were extended by our specimens.)

DISTRIBUTION.— Recorded from Maldives, Indonesia, Philippines, se. Australia, and now off Taiwan, in depths between approximately 1000 m and 1800 m.

REMARKS.— Howes and Crimmen (1990:195) treated the species as a member of *Gadomus* based on a specimen they erroneously considered a syntype, but which not only was non-type material but also a species different from the holotype (see Iwamoto and Merrett 1997:479). The large Taiwan specimen was similar in most mensurable and count characters to the specimens we called *B. antrodes*. However, its head bones were stouter, integument notably tougher, with scale



A



B

FIGURE 1. *Bathygadus furvescens* Alcock, 1894. A. ASIZP 65510, 475+ mm TL, preserved. B. ASIZP 63788, 1 of 4, 380+ mm TL, preserved.

pockets well developed, color overall paler, the interorbital width slightly narrower (27–28% HL), and none of the fin rays longer than the head. The specimen agreed in these respects with *B. furvescens* as circumscribed by Iwamoto and Graham (2001:422–423) and represents the first record of the species from Taiwan waters.

Bathygadus garretti Gilbert and Hubbs, 1916

Bathygadus garretti Gilbert and Hubbs, 1916:151–153, pl.8, fig. 1 (holotype USNM 76863, 513 TL, Suruga Gulf, Japan, *Albatross* sta. 5059, 197–297 fm [360–543 m]).

Bathygadus (*Melanobranchus*) *garretti*: Gilbert and Hubbs, 1920:380 (in key).

Bathygadus garretti: Okamura, 1970:34–36, pl. 12, text-fig. 17 (descr. based on paratype, USNM 135351); Okamura, 1984:197, 357, fig. 139 (descr. in Japanese and English; 7 spec., Okinawa Trough, 360–650 m).— Chiou et al., 2004b:42, fig. 6 (1 spec., Da-xi, NET).— Shao et al., 2008: table 2 (6 spec., NET, SWT, SCS).

Bathygadus nipponicus: Howes and Crimmen, 1990:191 (in part; synonymized *B. garretti* with *B. nipponicus*). Chiou et al., 2004b:42, fig. 7 (1 spec., NET).

MATERIAL EXAMINED (20 spec.).— **NET**: ASIZP 61226 (1, 86.5 HL, 446 TL); Da-xi; ASIZP 61227 (2, 70–77 HL, 362–380 TL); Da-xi; ASIZP 61228 (1, 96.8 HL, 458 TL); Da-xi, ASIZP 64274 (1, 91.3 HL, 365 TL); CP 235, 764 m; ASIZP 70241 (1, 281 TL); Da-xi; ASIZP 70244 (1,

153 TL); Da-xi; ASIZP 70246 (3, 127–175 TL); Da-xi; ASIZP 70249 (3, 360–456 TL); Da-xi; ASIZP 70253 (1, 444 TL); Da-xi. **SWT:** ASIZP 65512 (1, 58.1 HL, 320 TL); CP 130, 709–728 m; ASIZP 65593 (1, 70 HL, 338 TL); CD 140, 280–452 m; ASIZP 65599 (1, 65.6 HL, 291+ TL); CD 137, 316–477 m. **No data:** ASIZP 65580 (1, 71.6 HL, 335+ TL). **Other material: Japan:** BSKU 98225 (1, 62.5 HL, 305+ TL) and BSKU 98224 (1, 58.9 HL, 320 TL); Suruga Bay, 520–545 m; 23 Nov. 1978.

DISTINGUISHING FEATURES.— A species of *Bathygadus* with gular membrane scaled; a rudimentary chin barbel usually present (sometimes absent); dorsal profile behind head relatively low, nape not humpbacked; 1D II8–10; P i15–i18; V 10 (rarely 11); GR-I (5–6) + (17–20); pyl. caeca 34–46 (or more); interorbital width 27–32% HL; orbit diameter 21–26%; upper jaw length 52–58%; none of fins with greatly elongated rays.

DISTRIBUTION.— Southern Japan s. to Taiwan (NET, SWT) in 360–650 m.

REMARKS.— Our identification of specimens of this species was based on a combination of characters, including the presence of a rudimentary chin barbel. In a few specimens, the barbel was not present, but other characters that we deemed important appeared to confirm our identification. Howes and Crimmen (1990:1910) synonymized *B. garretti* with *B. nipponicus*, stating that the only difference between the two was the presence of a rudimentary chin barbel in the former, a suggestion made earlier by Okamura (1984:358). However, our ASIZ specimens suggest that *B. garretti* almost always has V 10 (11 on one side in a paratype) vs. mostly 9 in *B. nipponicus* (the holotype has 10, *vide* Okamura 1970 and Howes and Crimmen 1990, not 9 as stated in the original description), a slightly larger orbit (1–26% HL vs. 17–22%), and more pyloric caeca (34–46 [5 spec.] vs. 12–19 [5 spec.]). The count of pyloric caeca in the single paratype of *B. garretti* was given as 50 by Gilbert and Hubbs (1916:152), 49 by Okamura (1970:34), and 54 by Howes and Crimmen (1990:191).

Specimen ASIZP 61227, listed in Chiou et al. (2004b) as the first Taiwan record of *B. nipponicus*, was determined by us to be *B. garretti*. One of two specimens of *B. antrodes* (ASIZP 61226) recorded in the same paper is now re-identified as this species.

Bathygadus nipponicus (Jordan and Gilbert, 1904)

Regania nipponica Jordan and Gilbert, 1904:605–606, fig. (holotype, USNM 50931, 590+ TL; *Albatross* sta. 3721, Suruga Bay, Japan, 207–250 fm [379–457 m]).

Bathygadus nipponicus: Gilbert and Hubbs, 1916:142 (listed).— Okamura, 1970:33 (compiled).— Howes and Crimmen, 1990:191–192 (in part; holotype data; see Remarks under *B. garretti*).— Chiou et al., 2004b:42, fig. 7 (1 spec., NET, re-identified as *B. garretti*).— Shao et al., 2008: table 2 4 spec., NEW, SWT, SCS).

Bathygadus (*Melanobranchus*) *nipponicus*: Gilbert and Hubbs, 1920:380 (in key).

MATERIAL EXAMINED (6 spec.).— **SWT:** ASIZP 64117 (1, 60 HL, 210+ TL); CD 193, 821 m; ASZIP 65633 (3, 44–60.2 HL, 150–375 TL) and ASZIP 65634 (1, 66 HL, 264+ TL); CD 229, 880–1062 m. **SCS:** ASIZP 66126 (1, 83.0 HL, 480 TL); CD 320, 731 m.

DISTINGUISHING FEATURES.— A species of *Bathygadus* with gular membrane scaled; chin barbel absent; dorsal profile behind head relatively low, nape not humpbacked; 1D II,8–10, P i15–i17; V 9 (rarely 10); GR 6+(17–22) (ASIZP 65634 had 2 rudiments and 6 developed rakers on upper arm); pyl. caeca 12–19; interorbital width 27–32% HL; orbit diameter 22–26%; upper jaw length 53–56%; none of fins with greatly elongated finray.

DISTRIBUTION.— Southern Japan to Taiwan (SWT, SCS) in 731–1062 m.

REMARKS.— Jordan and Gilbert (1904:605) gave the gill raker count as 5+16 in the holotype and only specimen in their original description of the species; this count was confirmed by Howes

and Crimmen (1990:191). That the count is lower than the values in our specimens is somewhat unsettling, but we hold to our identification until the time more specimens become available and the holotype can be re-examined by one of us. So far as we can determine, our specimens represent only the second record of the species and the first from Taiwan. Chiou et al. (2004b:42, fig. 7) listed the species as a first record from Taiwan based on ASIZP 61227, but we re-examined that specimen and determined it to be *B. garretti*.

Bathygadus sp. indet.

ASIZP 64268 (1, 39.2 HL, 180+ TL), CD 191, 821 m. This specimen from 821 m in the SCS had interorbital 33% HL, orbit 20%, suborbital 14%, postorbital 56%, orbit-preopercle 49%, upper jaw 62%, and V 10, P 17–18, GR-I 5+19, characters that suggest *B. spongiceps*.

ASIZP 65634 (1, 264+ TL), CD 229, 880–1062 m. This specimen from SWT is in poor condition and most characters are undecipherable. Interorbital 23 mm, orbit 12.7 mm, orbit-preopercle 28 mm; V 9, GR-I 6+19. Head integument relatively tough; orbit too wide to be *B. garretti* or *B. nipponicus*.

ASIZP 66738 (1, 21.3 HL, 92+ TL), CD 324, 1293 m. This small specimen from 1293 m in the SCS had a broad interorbital (38% HL), small orbit (22%), deep suborbital (18%), and GR-I 5+18, characters that suggest *B. antrodes*.

ASIZP 66793 (1, 405 TL); CD 320, 731 m. This specimen from the SCS is in poor condition; it was originally identified as *Bathygadus entomelas*.

Genus *Gadomus* Regan, 1903

DISTINGUISHING FEATURES.— Chin barbel present, usually thick and long. V rays usually 8, rarely 9. Second spinous ray of 1D, upper ray of P, and outermost ray of V usually elongated, in some species extremely long; outer V ray usually rather thick.

REMARKS.— The genus was revised by Howes and Crimmen (1990), who based their work mostly on the literature and old, previously recorded specimens (none recently collected). With respect to *Gadomus aoteanus*, they followed McCann and McKnight (1980), who gave an erroneous count of V 9, but examination of the holotype and many other specimens (by TI) of that species showed that there are consistently eight rays in each fin. Gilbert (1905:658) gave a count of V 9 for the holotype (and only type specimen) of *G. melanopterus*; this is the only record of nine rays in a specimen of *Gadomus* that we are aware of. A second non-type specimen (CAS-SU 8545) that he reported in the original description has V 8.

Seven of the 12 described species of *Gadomus* are found in the western Pacific, but there may be others that are new to science. The species from the Indo-Pacific region have, for the most part, been inadequately circumscribed owing to the lack of large series from many localities. A thorough review of the genus using more recently collected material and genetic analyses is badly needed.

Gadomus colletti Jordan and Gilbert, 1904

Gadomus colletti Jordan and Gilbert, 1904:603–604 (holotype USNM 50930, Albatross sta. 3721, Suruga Bay, Japan; 207–250 fm [379–457 m]).— Gilbert and Hubbs, 1916:154–155 (descr.; 4 spec., 68–302 TL; Suruga Gulf, 211–293 fm [386–536 m]); Gilbert and Hubbs, 1920:392 (in key).— Okamura, 1970:23–26, pl. I, fig. a; text-fig. 12A, 13 (descr., 44 spec., 177–322 TL); s. Japan, 360–547 m).— Howes and Crimmen, 1990:199 (descr. based on holotype and USNM spec.).— Chiou et al., 2004b:43, fig. 8 (2 spec., NET).— Shao et al., 2008: table 2 (5 spec., NET, SCS).

Bathygadus colletti: Weber, 1913:172 (listed).

MATERIAL EXAMINED (6 spec.).— **NET:** ASIZP 61223 (1, 79 HL, 363 TL); Da-xi; ASIZP 61224 (1, 82.7 HL, 382 TL); Da-xi; ASIZP 65636 (1, 68.1 HL, 352 TL); CD 214, 488–1027 m; Da-xi. ASIZP 70251 (1, 90 HL, 346 TL); Da-xi. **SWT:** ASIZP 65513 (1, 200+ TL); CP 130, 709–728 m. **Other specimens: Japan:** HUMZ 37408 (1, 29.8 HL, 146+ TL).

DISTINGUISHING FEATURES.— A species of *Gadomus* with chin barbel about 2/3 of HL or slightly longer; elongated ray in 1D, P and V often longer than HL; 1D II,10–11; P (i16) i18–i21; V 8; outer gill rakers lathlike but relatively short, bluntly tipped, (4–5)+(8–21) (ASIZP 61224 had 1 rudiment and 5 developed rakers on upper arm, 16 developed and 3 rudiments on lower arm); pyl. caeca small, numerous, about 95 to 165. Interorbital width 14–18% HL; orbit diameter 22–23%; upper jaw length 51–58%; chin barbel 57–91%; 1D spinous ray less than twice HL. Color relatively pale, mouth and gill cavity dark but paler on outer margins; lips and barbel whitish; fins dusky to blackish, dorsal fins lighter basally.

DISTRIBUTION.— Southern Japan to Taiwan (NET, SWT) in 488–1027 m.

REMARKS.— This species was first recorded from Taiwan by Chiou et al. (2004b:43). Our four specimens appeared to have a somewhat shorter barbel (57–91% of HL) than reported by others. Okamura (1970:24) recorded their length as 0.9–1.2 into HL in 44 specimens from Japan, “about as long as, or a little shorter than, length of head” in 10 specimens from the Kyushu-Palau Ridge and Tosa Bay (Okamura 1982:345), and 75–91% HL in five specimens from the Okinawa Trough (Okamura 1984:356).

Gadomus magnifilis Gilbert and Hubbs, 1920

Figure 2.

Gadomus magnifilis Gilbert and Hubbs, 1920:398–401, fig. 4 (holotype USNM 78208; n. Mindanao; *Albatross* sta. 5515 in about 700 fm [1280 m]; 2 paratypes, Philippines; 508–554 fm [929–1014 m]).— Howes and Crimmen, 1990:197 (descr. from type spec.).— Shao et al., 2008: table 2 (1 spec., SWT, first record for Taiwan).

MATERIAL EXAMINED.— **SWT:** ASIZP 65627 (1, 70 HL, 385+ TL); CD 229, 880–1062 m.

DISTINGUISHING FEATURES.— A species of *Gadomus* with chin barbel about 29–72% of HL; length elongated P ray 2–3 times HL; prolonged ray in 1D and V greater than 1.5 times HL; 1D II,9–10; P i17–i18; V 8; outer gill rakers bluntly tipped, lathlike, short, about half orbit diameter, (5–6)+(21–23); pyl. caeca 24–29; interorbital width 16–17% HL; orbit diameter 21–24%; suborbital depth 10–15%; upper jaw length 55–60%; chin barbel 29–72% (compiled from Gilbert and Hubbs 1920 and ASIZP 65627).



FIGURE 2. *Gadomus magnifilis* Gilbert and Hubbs, 1920. ASIZP 65627, 385+ mm TL, preserved.

DISTRIBUTION.— Taiwan (SWT) to n. Mindanao, Philippines, in 929–1280 m.

REMARKS.— Our identification of the single Taiwan specimen is tentative. Its barbel length is somewhat shorter (29% HL cf. 61–72%) and suborbital somewhat deeper (15% HL cf. 10%) than in the type specimens of *G. magnifilis*. The Taiwan specimen appears similar to *G. introniger* in its gill-raker count, barbel length, orbit diameter, and bluntly tipped gill rakers, but differs in having a slightly narrower interorbital (17% cf. 20–23%), slightly deeper suborbital (15% cf. 10–13%), and longer orbit-to-preopercle distance (51% cf. 44–49%). The pyloric caeca could not be counted in our specimen because they had been previously extracted and were unavailable; they may have offered additional clues to the correct identity. Gilbert and Hubbs (1920:396) considered *G. denticulatus* as closely related to *G. magnifilis*, but compared to our specimen, *G. denticulatus* has a much narrower interorbital space (1.5–1.8 into orbit diameter cf. 1.3), slightly larger orbit (23–24% HL cf. 21% in our spec.), and slightly fewer gill rakers (4–6)+(17–22) (23–27 total), cf. 6+23 (29 total).

***Gadomus cf. multifilis* [sensu (Günther, 1887)]**

Figures 3A–B.

Gadomus multifilis (Günther, 1887): Shao et al., 2008: table 2 (4 spec., SWT, first record for Taiwan).

MATERIAL EXAMINED (9 spec.).— **SWT:** ASIZP 64092 (4, 30–50.6 HL, 130+–260+ TL); CD 193, 821 m. **SCS:** ASIZP 66334 (1, 38 HL, 240 TL) and ASIZP 66240 (1, 37.1 HL, 223+ TL), CD 307, 1591 m; ASIZP 66189 (1, 35.1 HL, 170+ TL) and ASIZP 66810 (1, 35.5 HL, 185+ TL); CD 322, 1098 m. **Other specimens:** ASIZP 68056 (1, 34.7 HL, 223 TL); CC2702 Aurora, 944–1004 m, 27 May 2007.

DISTINGUISHING FEATURES.— A species of *Gadomus* with chin barbel about 50–75% of HL; length elongated P ray 2–3 times HL, prolonged ray in 1D and V much greater than HL; 1D II,8–9, P i16–i19; V 8; outer gill rakers sharply tipped, lathlike (6–7) + (23–26); pyl. caeca 24–29. Interorbital width 16–17% HL, orbit diameter 21–24%; suborbital depth 10–15%; upper jaw length 55–60%; chin barbel 29–72% (compiled from Gilbert and Hubbs, 1920).

DISTRIBUTION.— Taiwan (SWT, SCS) and broadly across Indo-West Pacific, if these specimens are the same as *G. multifilis*.

REMARKS.— Our identification of nine Taiwan specimens has been problematical, although they for the most part fit the original description and subsequent descriptions of *G. multifilis* by Gilbert and Hubbs (1920) and Howes and Crimmen (1990). However, four of the ASIZ specimens (ASIZP 64092) have a slightly lower count of GR-I (6 + 23) and more pyloric caeca (30–47 in 4 spec.); ASIZP 66334 had more rakers, 7 + 26 rakers. Gilbert and Hubbs (1920:406–408) gave the gill-raker count as 6 + (26–27) and pyloric caeca as 12 and 16. Howes and Crimmen (1990:195–197) counted 6 + 25 gill-rakers for the holotype and eight other specimens, and counts of 25 and 15 pyloric caeca in two of those specimens. The low gill-raker counts and high pyloric caeca counts of ASIZP 64092 agree rather well with those Gilbert and Hubbs (1920:403) gave for *G. introniger* (gill-rakers (5–6) + (20–24) and “pyloric caeca [in several specimens, 35 to 52]”). However, the orbit diameter and interorbital width are less in our specimens and the gill-rakers are pointed, not bluntly tipped, as in *G. introniger*. Similarly, the counts of gill-rakers and pyloric caeca, plus the interorbital and orbit dimensions, agree closely with *G. magnifilis*, but the gill-rakers are also bluntly tipped in that species. We see no resolution to our dilemma without a thorough revision of the genus using extensive material from throughout the Indo-West Pacific, and especially from that critical region around the Philippine Islands and the Malay Archipelago.



FIGURE 3. *Gadomus cf. multifilis* [*sensu* (Ganther, 1887)] A. ASIZP 64092, 260+ mm TL, fresh. B. ASIZP 66334, 240 mm TL, preserved.

Family Macrouridae

Key to Genera and Some Species of Macrouridae in Taiwan

(number of species in Taiwan in parentheses after genus)

- 1a. Six branchiostegal rays 2
- 1b. Seven branchiostegal rays 4
- 2a. Spinous 1D ray smooth; a stout continuous suborbital ridge terminating posteriorly in a sharp point; V 7 *Coelorinchus* (23 spp.)
- 2b. Spinous 1D ray serrated (sometimes weakly) along leading edge; suborbital ridge not continuous and not ending in a sharp point; V 7–14 3
- 3a. Gill-rakers absent on lateral side of first gill arch; V7 or 8; anus in middle third of distance between V and A *Mataeocephalus hyostomus*
- 3b. Gill-rakers present on lateral side of first gill arch; V 7–14; anus usually immediately anterior to A *Coryphaenoides* (4 spp.)
- 4a. Abdomen and isthmus with patches of fine black striations with silvery underlayment (especially when fresh); small lens-like light organ on chest connected by black medioventral line to a

- second lens immediately before anus 5
- 4b. Abdomen and isthmus lacking areas of fine black striations; light organ, if present, not as above 7
- 5a. Nasal bones forming three flat platelike horizontal processes; gular membrane with net- or mesh-like pattern; prolonged distal portion of outer pelvic fin ray with narrow membranous flange *Spicomacrurus kuronumai*
- 5b. Nasal bones not forming horizontal platelike processes; gular membrane with thin black transverse lines at right angle to median line; outer pelvic fin ray tapers evenly to distal tip 6
- 6a. First dorsal fin with weakly denticulate spinous ray; gill rakers on inner side of first arch with 12–16 rakers on lower limb; V 7–9, usually 8. *Hymenogadus gracilis*
- 6b. First dorsal fin spinous ray entirely smooth along leading edge; gill rakers on inner side of first arch with 15–22 rakers on lower limb; V 7–12. *Hymenocephalus* (4 spp.)
- 7a. Anus and urogenital pore within broad black naked area, the periproct, the posterior border of which abuts origin of A and spans most of space between V and A. 8
- 7b. Periproct smaller, not occupying most of space between V and A; anus (and urogenital pore) either abuts A origin, or separated from A by several scales rows, sometimes closer to insertion of V than to origin of A 10
- 8a. Origin of V behind P origin; 2nd spinous ray of 1D smooth *Trachonurus* (2 spp.)
- 8b. Origin of V below or anterior to P origin; spinous 1D ray serrated along leading edge 9
- 9a. Head greatly inflated, broad and deep; snout fully scaled; a series of enlarged scales along anterior section of 2D *Cetonurus globiceps*
- 9b. Head not inflated, moderately compressed; underside of snout naked; no series of enlarged scales along 2D *Sphagemacrurus* (2 spp.)
- 10a. Olfactory organ massive, its diameter almost equal to that of orbit *Macrosmia phalacra*
- 10b. Olfactory organ small to moderate, much less than orbit diameter 11
- 11a. Most of dorsal surface and entire ventral surface of snout naked *Kumba* (3 spp.)
- 11b. Dorsal surface of snout fully scaled; ventral surface of snout variously naked. 12
- 12a. Lower jaws bearing enlarged, widely spaced, fang-like teeth in 1 or 2 rows; spinous 1D ray smooth *Malacocephalus nipponensis*
- 12b. Lower jaw teeth normal in size, closely spaced, none fang-like, in 2 or more rows to broad band; spinous 1D ray smooth or serrated along leading edge. 13
- 13a. V with 6 rays, placed anterior to P base; anus closer to A origin than to V insertion *Pseudonezumia pusilla*
- 13b. V with 7 or more rays, position variable from below 1D to under preopercle; anus removed from A origin, usually closer to V insertion 14
- 14a. Head broadly inflated, interorbital space about 40% of HL; orbit diameter less than 25% HL; suborbital deep, about 20% HL *Pseudocetonurus cf. septifer*
- 14b. Head not especially inflated, interorbital space less than 35% HL; orbit diameter usually more than 25% HL, suborbital less than 20% HL 15
- 15a. Terminal and lateral snout scutes present, the terminal scute paired; suborbital ridge marked by two rows of coarsely modified scales. 16
- 15b. Terminal and lateral snout scutes generally not well developed, the terminal scute single, if present, not large; no coarsely modified scales along suborbital ridge. 17
- 16a. Outer series of rakers on GR-I usually absent (sometimes with a few rudimentary spicules); V 7 or 8. *Mataeocephalus* (2 spp.)

- 16b. Outer series of rakers on GR-I always present, although sometimes rudimentary; V 7 to 17.
..... *Nezumia* (5 spp.)
- 17a. Upper jaw extending to below posterior one-third or more of orbit; premaxillary tooth band extends posteriorly beyond maxillary process; inner series of gill rakers on GR-I 14–20 total; no scales on gular or branchiostegal membranes *Ventrifossa* (9 spp.)
- 17b. Upper jaw extending posteriorly to below anterior half of orbit; premaxillary teeth band does not extend beyond maxillary process; gill rakers on inner series of first arch usually less than 14 total; some species with scales on gular or branchiostegal membranes. 18
- 18a. Color brown to blackish, no silvery pigmentation; fins uniformly blackish; teeth in broad bands. *Kuronezumia dara*
- 18b. Color pale to greyish; silvery pigmentation ventrally in fresh specimens; fins often with black blotches or streaks; teeth in relatively narrow bands. *Lucigadus nigromarginatus*

Genus *Cetonurus* Günther, 1887

DISTINGUISHING FEATURES.— A distinctive genus owing to its large, soft, globose head, fully scaled including branchiostegal rays (and gular membrane in some specimens); enlarged scales along dorsal-fin interspace and anterior portion of 2D; interrupted lateral line; BR 7; large periproct region spanning most of the short space between V and A; and serrated spinous 1D ray.

REMARKS.— Two species recognized, one in our area; genus reviewed by Sazonov and Shcherbachev (1985).

Cetonurus globiceps Vaillant, 1884

Figures 4A–B.

Macrurus globiceps Vaillant in Filhol 1884:183, fig. 2 (name and figure, Spanish Sahara; lectotype: MNHN 1886–0092; 7 paralectotypes).

Hymenocephalus crassiceps (non Günther, 1878): Vaillant, 1888:214–218, pl. 20, figs. 1, 1a–e (descr.; Atlantic off France, North Africa, and Azores)

Cetonurus robustus Gilbert and Hubbs, 1916:207–210, pl. 11, fig. 2 (holotype USNM 76870, Albatross sta. 4971, off central Hondo [Honshu], Japan, 33°23'30"N, 135°34'00"E; 649 fm [1187 m]; 4 paratypes, sta. 4973, 600 fm [1097 m])

Cetonurus globiceps: Sazonov and Shcherbachev, 1985 (descr., distr.). Iwamoto and Williams, 1999:169 (7 spec., w. and se. Australia, 792–1030 m).— Iwamoto and Graham, 2001:458 (17 spec., 940–1200 m).— Shao et al., 2008: table 2 (3 spec., SET, SCS, 998–1290 m; first Taiwan record)

MATERIAL EXAMINED (5 spec.).— **SCS:** ASIZP 65559 (1, 170+ TL); CD 136, 998–1211 m; ASIZP 66095 (1, 270+ TL); CD 324, 1293 m. **SWT:** ASIZP 65620 (1, 331 TL); CD 228, 1262–1290 m. **SET:** ASIZP 67020 (1, 310+ TL, 61 HL); CP 353, 1205 m. **Other material:** ASIZP 68059 (1, 390 TL); Aurora, the Philippines.

DISTINGUISHING FEATURES.— A species of *Cetonurus* with large orbit (24–28% HL); small scales (18–19 rows below 1D and 14–16 rows below 2D); and 3–4 rows of closely spaced teeth on premaxilla. Size to 510 mm TL.

DISTRIBUTION.— This species is widespread in tropical and subtropical waters of the Indo-West Pacific and Atlantic but is absent in the central and e. Pacific. In the w. Pacific it is found off Japan, Taiwan, New Zealand, and Australia. Four specimens were collected in the South China Sea and the s. coast of Taiwan at depths between 998 and 1293 m.

REMARKS.— The only congener, *C. crassiceps* (Günther, 1878), is a closely similar species that has been recorded from the Kermadecs, Hawaiian Islands, Vanuatu, Loyalty Ridge, Norfolk



FIGURE 4. *Cetomurus globiceps* Valliant, 1884. A. AISZP 67020, 310+ mm TL, fresh. B. ASIZP 65559, 170+ mm TL, preserved.

Ridge, Lord Howe Rise, and in the central and South Atlantic. Characters used by Sazonov and Shcherbachev (1985) to distinguish the only two members of the genus are weak and need to be further tested. Three of the specimens here listed were the basis for Shao et al.'s (2008:fig. 2) first record of the species from Taiwan.

Genus *Coelorinchus* Giorna, 1810

DISTINGUISHING FEATURES.— BR 6; suborbital ridge formed of stout, coarsely spined, modified scales extending continuously from tip of snout to posterior angle of preopercle, ending in a sharp point; second spinous ray of first dorsal fin smooth along leading edge (some juveniles and exceptional adults may have a few spinules near distal tip); ventral light organ variously developed, from small gland anterior to anus not externally visible, to large prominent organ with one or two dermal fossae along ventral midline; no rakers along outer (lateral) side of first gill arch. V almost always 7, rarely 6.

REMARKS.— The most diverse genus of family Macrouridae with more than 118 recognized species, categorized by some into as many as seven subgenera; 23 species known from Taiwan. Relationships closest to *Macrourus*, the only significant differences between the two genera the presence of denticulations on spinous second ray of 1D and generally more pelvic fin rays (8 or 9, rarely 7) in *Macrourus*. Preliminary cladistic analysis (e.g., Roa-Varón and Ortí 2009:700) suggests that *Macrourus* is deeply nested within *Coelorinchus*, a situation that could prove to be a nomenclatural nightmare. Greatest diversity found in tropical regions of the Indo-West Pacific. Species most common in upper- to middle-slope waters between 200 and 1000 m, although some species range into shallow continental-shelf depths and others into depths greater than 1000 m. Many

species of shallower waters are highly restricted in their geographic distribution. Maximum size attained range from about 20 cm TL to more than 87 cm.

In statements concerning the ventral light organ, Groups I through IV refer to categories assigned by Iwamoto (1990) based on the external development of the dermal window of the light organ.

Key to the Species of *Coelorinchus* in Taiwan

- 1a. Light organ with two widely separated, usually blackish fossae, one immediately behind isthmus, the second immediately before anus, both connected by a medioventral line; anus/urogenital opening immediately before A origin; ventral snout surface with a series of overlapping scales at anterolateral margin. 2
- 1b. Light organ variously developed, from scarcely visible to prominent with a single large fossa between or slightly anterior to V bases; anus/urogenital opening immediately before or separated by several scale rows from A origin; no overlapping series of scales ventrally on anterolateral snout margin 9
- 2a. Underside of head behind mouth mostly scaled *C. formosanus*
- 2b. Underside of head essentially wholly naked (tiny isolated scales sometimes present above posterior angle of mouth and on preopercle) 3
- 3a. Anterior rays of 2D about equal in height to those of A. 4
- 3b. Anterior rays of 2D decidedly shorter than those of A. 7
- 4a. Body with prominent dark longitudinal stripes *C. hubbsi*
- 4b. Body with prominent saddles or completely lacking body markings 5
- 5a. No body markings; snout rather short, broad, depressed, 39–44% HL. *C. brevirostris*
- 5b. Prominent saddle marks on body; snout 36–50% HL 6
- 6a. 1D with elongated spinous ray; BR membrane dusky to pale. *C. cingulatus*
- 6b. No elongated spinous ray in 1D; BR membrane dark to black *C. fuscigulus*
- 7a. Body covered with bold vermiculations and blotches, more or less aligned in 2 or 3 longitudinal rows; origin of 2D slightly before vertical through A origin; 1D-2D interspace about equal to length base of 1D *C. multispinulosus*
- 7b. Body immaculate or with irregular, sometimes faint, markings; origin of 2D about on same vertical as, or somewhat behind, A origin; 1D-2D interspace greater than length base of 1D 8
- 8a. Gular and branchiostegal membranes heavily peppered with black pigmentation, chest region relatively dark, underside of head covered with tiny black sensory papillae; spinules on body scales broadly triangular, in irregular, somewhat quincunx pattern *C. kamoharai*
- 8b. Underside of head faintly dusky to immaculate, chest region light dusky, sensory papillae on underside of head scattered and inconspicuous; spinules on body scales weak, small, in 6–14 somewhat parallel to divergent rows *C. longissimus*
- 9a. Snout relatively blunt, not acutely pointed; a distinct curve in anterior portion of suborbital shelf; anus about midway between A origin and base of outer V rays, preceded by large black fossa of light organ *C. macrochir*
- 9b. Snout acutely pointed in lateral view; suborbital shelf lacking distinct curve anteriorly; anus closer to A origin than to base of outer V rays, fossa of light organ present or absent 10
- 10a. A blackish round blotch above P; anus removed from A by several scale rows; large fossa of light organ extending forward between V bases 11

- 10b. No blackish blotch above P; anus immediately before or removed from A origin; light organ situated posterior to V bases 12
- 11a. Black blotch above P large, spanning 5–7 diagonal rows of scales; gular and branchiostegal membranes black; height 1D 45–54% of pre-vent length *C. kishinouyei*
- 11b. Black blotch above P small, spanning 3 or 4 diagonal scale rows; gular and branchiostegal membranes pale or whitish; height 1D 67% of pre-vent length. *C. cf. notatus*
- 12a. Underside of head entirely or almost entirely naked (underside of head completely naked except for ventral portion of preopercle in *C. hexafasciatus*) 13
- 12b. Underside of head scaled (underside of snout naked in *C. leptorhinus*, but posteriorly head scaly) 16
- 13a. Dark saddles on trunk and tail *C. hexafasciatus*
- 13b. No saddle marks on body 14
- 14a. Spinules on body scales below 2D with 3–5 divergent rows of strong, triangular spinules, middle row higher than lateral rows *C. productus*
- 14b. Spinules on body scales below 2D with 4–11 somewhat parallel to divergent, sharply crest-like rows of narrow, triangular spinules. 15
- 15a. Scales of median nasal ridge 9–12, spinule rows directed laterally and posteriorly only *C. anatirostris*
- 15b. Scales of median nasal ridge 6–8, with spinules radiating in all directions *C. asteroides*
- 16a. Prominent saddle markings on body; snout tip lacking sharp terminal scute *C. sheni*
- 16b. No saddle markings on body; a sharp terminal snout scute present. 17
- 17a. Underside of snout naked (head scaly from above mouth posteriorly) *C. leptorhinus*
- 17b. Underside of snout and head fully scaled. 18
- 18a. Anterolateral margin of snout incompletely supported by bone. 19
- 18b. Anterolateral margin of snout completely supported by bone 20
- 19a. Body scales with 4–6 parallel rows of strong, high, usually broad-based (i.e., large lateral buttresses) spinules; scales between occipital ridges and on underside of head mostly with one spinule row *C. parallelus*
- 19b. Body scales with 3–8 somewhat parallel to broadly divergent rows of spinules; scales between occipital ridges with 1–5 spinule rows, on underside of head with 1–3 rows *C. divergens*
- 20a. Light organ visible only as crescent-shaped area of perianal ring, no separate fossa; most scales between occipital ridges with a single row of spinules *C. japonicus*
- 20b. Light organ with short fossa extending anteriorly almost to or between V fins; scales between occipital ridges with 2–5 rows of spinules 21
- 21a. Nasal fossa naked; large strong spinules on body scales in 3 divergent rows; scales between occipital ridges with a single row of spinules *C. cf. spinifer*
- 21b. Nasal fossa usually scaled anteroventrally, seldom naked; spinules on body scales in 4–6 (3–7) divergent rows; scales between occipital ridges with multiple rows (usually 2–4) of spinules 22
- 22a. Length 1D base 1.2 times into 1D-2D interspace; nasal fossa densely scaled anteroventrally *C. cf. macrorhynchus*
- 22b. Length 1D base 1.3–2.0 times into 1D-2D interspace; nasal fossa rather sparsely scaled on anteroventral surfaces, sometimes naked *C. smithi*

***Coelorinchus anatirostris* Jordan and Gilbert, 1904**

Coelorhynchus anatirostris Jordan and Gilbert, 1904:619 (holotype: USNM 51471 [ex CAS-SU 8550], 40 cm long; Misaki, Japan).— Okamura, 1970:186–189, pl. VIII, text-fig. 80 (72 spec.; s. Japan, 300–540 m).— Okamura *in* Okamura et al., 1982:171, 352 (2 spec.; s. Japan).— Okamura *in* Masuda et al., 1984:98, pl. 83E.— Yatou *in* Okamura and Kitajima, 1984:233, 368 (4 spec.; Okinawa Trough, 300–550 m).

Coelorinchus anatirostris: Iwamoto, 1990:141 (compiled).— Shen et al., 1993:168.— Shao et al., 2008: table 2 (5 spec., NET, SWT, 200–441 m).

Caelorinchus anatirostris: Iwamoto and Merrett, 1997:486, fig. 6c (7 spec., New Caledonia, Chesterfield and Ballona Plateau, 600–855 m).— Merrett and Iwamoto, 2000:743 (7 spec., Vanuatu, New Caledonia, 450–1160 m).— Chiou et al., 2004b:36, 47 (in key, Taiwan, listed).

MATERIAL EXAMINED (20 spec.).— **NET**: ASIZP 61324 (1, 346 TL), Da-xi; ASIZP 65572 (1, 432 TL), Da-xi; ASIZP 70217 (3, 157–337 TL), Da-xi; ASIZP 70219 (3, 330–358 TL), Da-xi; ASIZP 70698 (1, 79 HL, 272+ TL); Da-xi; CAS 214596 (2); Da-xi; CAS 214728 (4, 215+–325+ TL), Su-ao. **SWT**: ASIZP 65540 (4, 160+–255 TL), CD 138, 441 m. **SCS**: CAS 224495 (ex ASIZP 65594) (1, 63.1 HL, 227 TL), CD 141, 985–1110 m.

DISTINGUISHING FEATURES.— 1D II 8–10; P i16–i18; GR-I (inner) 5–7 (total). Scales below midbase 1D 3.0–4.5, below 2D 4–6; pyl. caeca 21–30. Snout pointed, length moderate, 38–45% HL, 1.3–1.6 times orbit; preoral length 36–40% HL; anterolateral margin of snout completely supported by bone; orbit 26–31% HL; upper jaw 21–27% HL. Nasal fossa scaled ventrally; underside of head naked except for two small scale patches under orbit and preopercle angle; light organ group II of Iwamoto (1990), fossa narrow and short, not extending to V bases; median rostral ridge scales 9–12, with spinules radiating laterally and posteriorly; body scales covered with narrowly triangular spinules in 4–10 (usually 6–8) slightly divergent, ridgelike rows, median row strongest. Dorsally grayish, ventrally heavily peppered over ivory ground, bluish over abdomen, pale over chest; mouth and gill cavity grayish to blackish; leading edge of 1D black, other fins dusky to pale. Attains about 430 mm TL.

DISTRIBUTION.— Widely distributed in the w. Pacific from s. Japan and East China Sea, Taiwan, New Caledonia, Chesterfield and Bellona Plateau, Vanuatu, and off ne. Australia. Depth range 300–1160 m.

REMARKS.— An apparent distributional gap in the Philippines and East Indies is somewhat disconcerting; specimens from the sw. Pacific should be carefully compared with those from Taiwan and points north. Specimen CAS 224495 from the SCS has scale spinules that are short and uniform, unlike those in others in the materials examined, and the snout seemed too slender for the species. It is tentatively included here, but should be further compared with other closely related species. Among Taiwan species, *C. anatirostris* is most closely similar to *C. productus* and *C. asteroides*, but the former has stronger and fewer (3–5) divergent rows of spinules on body scales and the latter has fewer scales (6–8) on the median rostral ridge. Fukui et al. (2009) synonymized *C. anatirostris* and *C. productus*, but we have reservations about accepting their conclusion (see discussion in description of *C. productus*).

***Coelorinchus asteroides* Okamura, 1963**

Coelorhynchus asteroides Okamura, 1963:21, figs. 1–4 (holotype, FAKU 23801, 7 paratypes; off Owase, Mie Pref., Japan).— Okamura, 1970:189–192, pl. XLI, text-figs. 81, 82 (8 spec., s. Japan, 320–360 m).— Okamura *in* Masuda et al., 1984:98, pl. 83F.— Yatou *in* Okamura and Kitajima, 1984:235, 369 (5 spec., Okinawa Trough).

Caelorinchus asteroides: Chiou et al., 2004b:43, fig. 9 (2 spec., NE, SW Taiwan).

Coelorinchus asteroides: Shao et al., 2008: table 2 (3 spec., NET, SWT, 100–452 m).

MATERIAL EXAMINED (8 spec.).— **NET:** ASIZP 61339 (1, 302 TL); Da-xi; ASIZP 65658 (1, 250+ TL); Da-xi. **SWT:** ASIZP 61340 (1, 310 TL); Dong-gang; ASIZP 62194 (2, 224–224 TL); Dong-gang; ASIZP 65560 (1, 230+ TL); CD 140, 280–452 m; ASIZP 70617 (1, 159 TL); Dong-gang. **Other specimens:** ASIZP 68016 (1, 375 TL); Aurora, 909–922 m.

DISTINGUISHING FEATURES.— 1D II, 7–9; P i15–i19; GR-I (inner) 5–7 (total); scales below midbase 1D. 3.0–4.5, below 2D. 4.0–5.5; pyl.caeca 40–50. Snout fairly broad, tipped with a slender sharp scute, length 39–46% HL, 1.3–1.5 times orbit, preoral length 32–35% HL; anterolateral margin of snout completely supported by bone; orbit 25–31% HL; upper jaw 22–29% HL. Nasal fossa naked ventrally; underside of head naked; median rostral series of scales 6–8, with spinules radiating in all directions; body scales with short, sharp lanceolate to triangular spinules in 4–11 slightly divergent rows, the median row strongest. Light organ group II, fossa narrow and short. Ground color grayish, silvery ventrally, abdomen bluish, paler anteriorly on chest; mouth dark, gill cavity blackish. Attains more than 390 mm TL.

DISTRIBUTION.— Geographically very confined; East China Sea from s. Japan to SCS off Taiwan, in 100–600 m.

REMARKS.— First recorded from Taiwan by Chiou et al. (2004b). Among the Taiwan members of the genus, *C. asteroides* is most likely to be confused with *C. anatirostris*, but it has fewer platelike scales on the median rostral ridge, and the spinule rows on these scales are arranged radially in all directions, compared to the lateral and posterior orientation of rows in *C. anatirostris*.

Coelorinchus brevirostris Okamura, 1984

Coelorhynchus brevirostris Okamura in Okamura and Kitajima, 1984:225 (holotype, BSKU 29562; Okinawa Trough, 25°47.4'N, 124°23.4'E, 600 m.).

Coelorinchus brevirostris: Chiou et al., 2004b:301 (redescription, 11 spec., Taiwan).

Coelorinchus brevirostris: Shao et al., 2008: table 2 (6 spec., NET, ET, SCS, 445–1185 m).

MATERIAL EXAMINED (21 spec.).— **NET:** ASIZP 61350 (1, 175+ TL), Da-xi; ASIZP 61351 (1, 213+ TL), Da-xi; ASIZP 61352 (1, 144 TL), Da-xi; ASIZP 65613 (1, 175+ TL), CP 120, 520–640 m; ASIZP 65518 (1, 183+ TL), 24.66°N, 122.18°E, CD 209, 508–522 m; ASIZP 66806 (1, 44.6 HL, 163+ TL.); CP 315, 509 m; ASIZP 66814 (4, 110–200 TL); CD 311, 516 m; CAS 215542 (2, 51.9 HL, 215+TL); Da-xi; CAS 228339 (1, 215+ TL); Nan-fang-ao. **ET:** ASIZP 65519 (1, 215 TL) and ASIZP 65615 (1, 134+ TL), CD 210, 445–1185 m. **SCS:** ASIZP 65675 (1, 140+ TL), CD 311, 516 m; ASZIP 66170 (1, 196+ TL) and ASIZP 66191 (1, 170+ TL), OCP 313, 513 m; ASIZP 66186 (1, 194+ TL) and ASIZP 66874 (1, 92+ TL), 21.67°N, 117.72°E, CP 314, 506 m; CAS 224494 (ex ASIZP 66182) (1, 185 TL), 21.67°N, 117.72°E; coll. P-F Lee, 17 Aug. 2005.

DISTINGUISHING FEATURES.— 1D II 7–8; P i14–17; GR-I (inner) 6–8 (total); scales below midbase 1D 4.5–5.5, below 2D 4.5–5.5; pyl.caeca 13–16. Snout rather short, broad, and depressed, 39–44% HL; terminal scute small; anterolateral snout margin incompletely supported by bone; orbit 25–28% HL; 1.5–1.7 in snout length; upper jaw 21–24% HL; body terete. Underside of snout and head naked; nasal fossa scaled; body scales large, with 5–8 parallel spinule rows. Second spinous ray of 1D prolonged, 1.3 times HL; rays of 2D well developed, about as long as opposite rays in A. Light organ group IV (of Iwamoto in Cohen et al. 1990), extends from anus to just behind isthmus. Body without prominent markings. Attains about 220 mm TL.

DISTRIBUTION.— East China Sea (Okinawa Trough) n. of Ishigaki Is. to sw. Taiwan in South China Sea at depths of 400–1185 m.

REMARKS.— The species was originally described from a single specimen taken in the East China Sea in 600 m, but subsequently redescribed by Chiou et al. (2004b) from 11 specimens col-

lected from ne. Taiwan. More specimens were recently collected from the South China Sea at depths between 445 and 1185 m (see Shao et al. 2008: table 2). Our specimens agree well with the original description except that they had fewer P rays (14–17 versus 19) and a shorter barbel (16–20% of orbit versus 24.7%). However, one of us (NN) re-examined the holotype and found P i16–i17 and barbel length 15% of orbit diameter, which is in agreement with our Taiwan specimens.

Among the Taiwan species of *Coelorinchus*, *C. brevirostris* is likely to be confused only with the recently described *C. fuscigulus* and *C. cingulatus*, but the lack of body markings distinguishes it from other members of the genus having an elevated 2D and long light organ with the anterior fossa just posterior to isthmus.

***Coelorinchus cingulatus* Gilbert and Hubbs, 1920**

Coelorhynchus cingulatus Gilbert and Hubbs, 1920:480, fig. 15 (holotype, USNM 78221, South China Sea, near Taiwan, 421 m; paratype, USNM 78223, off n. Luzon, 410 m).

Coelorinchus cingulatus: Okamura in Okamura and Kitajima, 1984:229, 366 (1 spec., Okinawa Trough, 250 m). Shen 1984:146.— Shao et al., 2008: table 2 (17 spec., NET, SWT, SCS, 236–1211 m).

Coelorinchus cingulatus: Iwamoto and Merrett, 1997:493–495, fig. 8 (17 spec., New Caledonia region, e. coast Australia; 480–580 m).— Merrett and Iwamoto, 2000:744 (5 spec., New Caledonia, Vanuatu, 460–525 m).— Chiou et al., 2004b:37, 47 (in key, listed from Taiwan).

MATERIAL EXAMINED (29 spec.).— **NET**: ASIZP 63249 (1, 233 TL), Da-xi; ASIZP 64545 (2, 152–155 TL), Nan-fang-ao; ASZIP 65662 (1, 232 TL), Da-xi; ASIZP 70211 (5, 263–304 TL), Da-xi; ASIZP 70245 (1, 205 TL), Da-xi. **SWT**: ASIZP 65520 (6, 120–173 TL), CD 137, 316–477 m; ASIZP 65582 (2, 195–200 TL), CD 141, 985–1110 m; ASIZP 65583 (5, 175–200 TL), CD 136, 998–1211 m; ASIZP 65605 (2, 160–170 TL), CD 138, 441 m; ASIPZ 66183 (1, 240 TL), OCP 313, 513 m. **Other specimens**: ASIZP 67859 (1, 234 TL), Aurora, 422–431 m; ASIZP 67962 (1, 154 TL), Aurora, 431–493 m; ASIZP 68017 (1, 226 TL), Aurora, 357–367 m.

DISTINGUISHING FEATURES.— 1D II 8–9; P i16–19; GR-I (inner) 6–8 (total); scales below mid-base 1D 3.5–5.5, below 2D 4.5–6.5; pyl.caeca 10–15. Snout sharply pointed, 43–50% HL; terminal scute slender, sharp; anterolateral snout margin incompletely support by bone; orbit 22–26% HL, 1.6–2.2 in snout length; upper jaw 19–24% HL; body somewhat cylindrical, greatest width slightly less than greatest depth. Underside of snout and head naked; nasal fossa naked or sparsely scaled; body scales large, densely covered with 7–15 parallel spinule rows. Second spinous ray of 1D slightly prolonged; rays of 2D well developed, almost as long as opposites in anal fin. Light organ group IV, extends from anus to just behind isthmus. A series of dark saddles on body, anterior two directed obliquely downwards and forward. Attains about 300 mm TL.

DISTRIBUTION.— Originally described from the South China Sea near Taiwan and n. Luzon, but subsequently recorded from Japan (East China Sea), the e. coast of Australia, and the regions around New Caledonia, Vanuatu, and Loyalty Island. It was collected in Taiwan (NET, SWT) at depths between 236 and 1211 m.

REMARKS.— Specimens from the sw. Pacific show slight differences from those from the n. hemisphere, but we have not been able to tease out any specific characters that would differentiate the populations. The species is most likely to be confused with *C. fuscigulus*, but that species lacks an elongated 1D spinous ray and has differences in body markings.

***Coelorinchus divergens* Okamura and Yatou, 1984**

Figures 5A–C.

Coelorinchus divergens Okamura and Yatou in Okamura and Kitajima, 1984:236–239 (holotype, BSKU 26865, Okinawa Trough [East China Sea] sw. of Kyushu, Japan, 1000 m; paratype, BSKU 33464, Okinawa Trough, 780–810 m).— Shao et al., 2008: table 2 (15 spec., NET, SCS, SWT, 646–1110 m; first record from Taiwan).

MATERIAL EXAMINED (17 spec.).— **NET:** ASIZP 64145 (1, 280+ TL), CP 235, 764 m; ASIZP 65575 (1, 286 TL), Da-xi; ASIZP 65577 (1, 245 TL), CP 196, 646–787 m. **SWT:** ASIZP 63799 (1, 338 TL), CD 193, 821 m; ASIZP 65538 (1, 330 TL), CD 141, 985–1110 m. **SCS:** ASIZP 66084 (1, 74 HL, 212+ TL), ASIZP 66788 (2, 260+–295+ TL), and ASIZP 66838 (1, 166+ TL), CD 321, 954 m; ASIZP 66752 (5, 225+–350+ TL) and CAS 224888, ex ASIZP 66752 (2, 323+–385+ TL), CD 320, 731 m. **Other specimens:** ASIZP 68052 (1, 398 TL), Aurora, 944–1004 m.

DISTINGUISHING FEATURES.— 1D II, 7–8; P i17–i18; GR-I (inner) 8(total); scales below mid-base 1D 4–5, below 2D 4.5–5.5; lateral line scales over distance equal to pre-1D length 30–31; pyl.caeca 9–11. Snout broadly spade-shaped (viewed dorsally), sharply pointed, length 38–45%

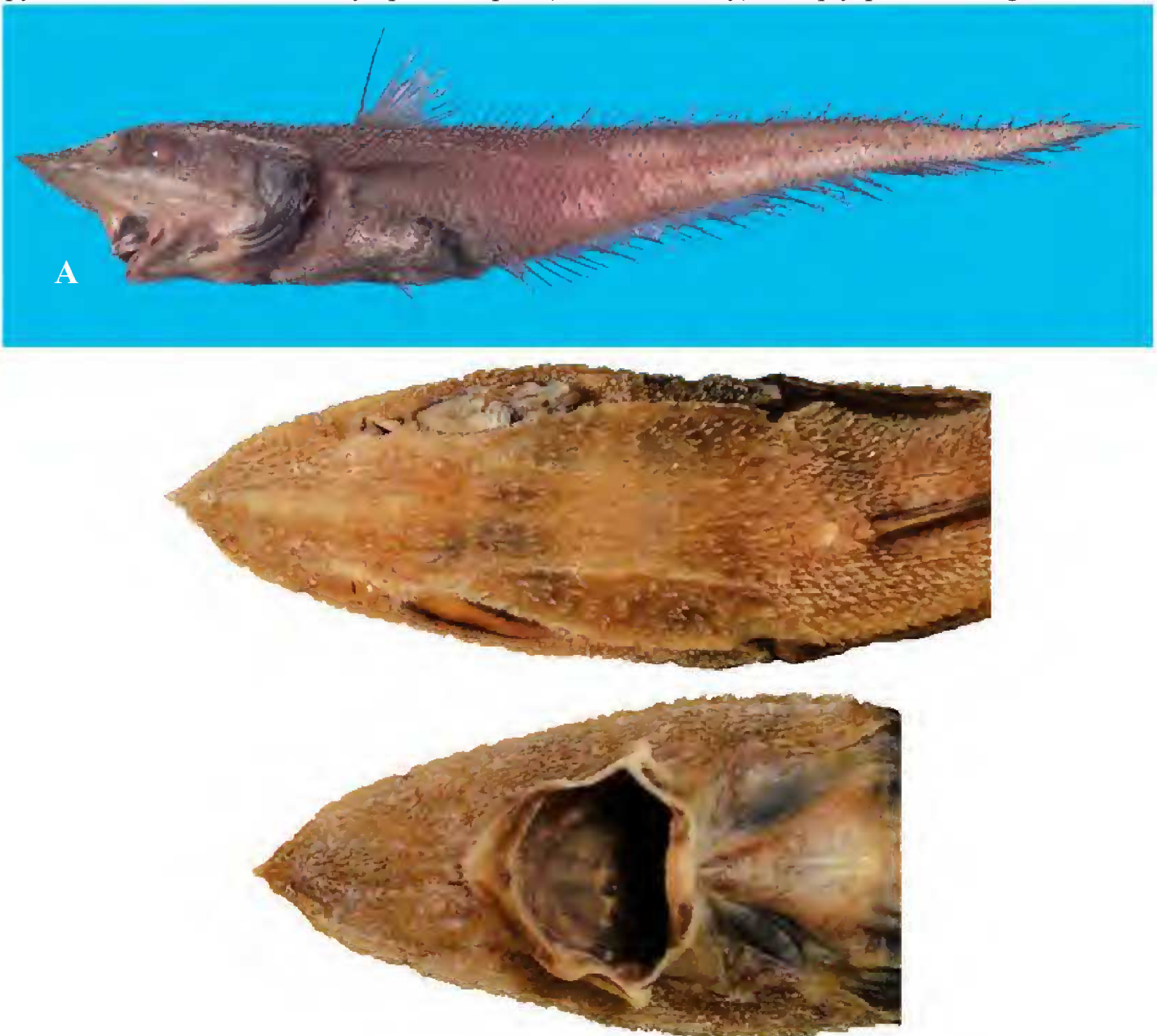


FIGURE 5. *Coelorinchus divergens* Okamura and Yatou, 1984. A. ASIZP 64145, 280+ mm TL, fresh. B-C. CAS 224888, 385+ mm TL, preserved, dorsal view (B) and ventral view (C) of head.

HL, terminal scute relatively small but pointed, anterolateral margin snout incompletely supported by bone; orbit 24–28(32)% HL, 1.4–1.8 in snout; interorbital 23–27%, postorbital 32–39%, orbit-preopercle 34–37%, upper jaw 26–31%, barbel 8–14%; preanal length 161–163%; height 1D 48–49%; length P 41–42%; isthmus to A 38–40%. Nasal fossa sparsely scaled anteroventrally; scales atop head with 2–5 crestlike rows of spinules in parallel to slightly divergent rows; scales on underside of head with broad, high spinules aligned in one (rarely 2) crestlike row; body scales large, thick, adherent, spinules in about 5 divergent ridgelike rows, middle row enlarged, spinule rows flanking middle row much lower, incomplete, not reaching scale margin. Light organ short, narrow, Group II. Ground color in alcohol brownish or grayish; fins dark or dusky; mouth, gill cavities, branchiostegal membranes, and jaws blackish. Attains at least 40 cm TL.

DISTRIBUTION.— Known from East China Sea, Taiwan, and South China Sea in 646–1110 m.

REMARKS.— Our specimens (as reported by Shao et al. 2008) represent the first record of the species from Taiwan and the South China Sea. According to Okamura and Yatou (*in* Okamura and Kitajima 1984) this species is very similar to *C. parallelus* Günther and *C. kermadecus* Jordan and Gilbert, but can be distinguished from the former in having 2–5 spinule rows (vs. single row) on scales atop head, slightly shorter snout (38–45% HL vs. 42–48% HL), and longer upper jaw (26–31% vs. 22–26%). *Coelorinchus kermadecus* differs from *C. divergens* in having 3–5 spinule rows (vs. 1 row) on scales on the underside of head, a longer snout (44–48% HL), and shorter upper jaw (23–26%).

Coelorinchus formosanus Okamura, 1963

Coelorhynchus formosanus Okamura, 1963(Mar.):37 (holotype FAKU 35856, Da-xi, Taiwan; 4 paratypes, FAKU 35857–60).— Okamura, 1970:161–165, pl. XXXIV, text-figs. 65, 66 (descr. from type specimens).

Coelorhynchus intermedius Chu and Lo in Chu, Chan and Chen, 1963 (Aug.):173, fig. 139 (East China Sea).— Xiong, Zhan, and Deng 1988:187–188, fig. 148 (4 spec., 164–238 mm TL; East China Sea off Ryukyu Is., 28°48'N, 127°00'E, 213–285 m).

Coelorhynchus abbreviatus Chu and Lo in Chu, Chan and Chen, 1963(Aug.):174 (East China Sea).

Coelorinchus formosanus: Okamura *in* Masuda et al., 1984:97, pl. 82–J.— Shao et al., 2008: table 2 (9 spec., NET, SCS, SWT, 600–1110 m).

Coelorinchus formosanus: Iwamoto, 1990:158 (descr.). Shen et al., 1993 (descr.).— Chiou et al., 2004b:37, 47 (in key, list).

MATERIAL EXAMINED (38 spec.).— **NET**: FAKU 35836 (holotype), Da-xi; FAKU 35857 (paratype), Da-xi; ASIZP 57976 (1, 184 TL), Da-xi; ASIZP 61048 (1, 220 TL), Da-xi; ASIZP 61342 (1, 272 TL), Da-xi; ASIZP 65584 (3, juveniles), CP 119, 123–140 m; ASIZP 65650 (1, 251 TL), Da-xi; ASIZP 65661 (1, 260+ TL), Da-xi; ASIZP 65664 (1, 310 TL), Da-xi; ASIZP 61342 (1, 272 TL), Da-xi; ASIZP 70693 (5, 224–333 TL), Da-xi; ASIZP 70714 (1, 154 TL), Da-xi; CAS 214457 (2, 278–297 TL), Su-ao; CAS 224169 (1, 242 TL), Da-xi. **SWT**: ASIZP 65595 (4, 215–305 TL), CD 141, 985–1110 m; ASIZP 65822 (1, 218 TL), Dong-gang; ASIZP 58024 (1, 173 TL), Dong-gang; ASIZP 62195 (1, 168 TL), Dong-gang; ASZIP 62196 (2, 156–160 TL), Kaoshiung; ASIZP 62197 (2, 260–297 TL), Dong-gang; ASIZP 70661 (3, 84–165 TL), Dong-gang. **NT**: ASIZP 61009 (1, 215 TL), Jin-shan; ASIZP 65568 (1, 326 TL), Da-xi. **No data**: ASIZP 65578 (1, 322 TL).

DISTINGUISHING FEATURES.— 1D II, 8–10; P i15–i18; GR-I (inner) 7–9 (total); scales below midbase 1D 3.5–4.5, below 2D 3.5–4.5; pyl.caeca 9–12. Snout sharply pointed, length 42–45% HL, anterolateral margin snout incompletely supported by bone; orbit 22–26% HL, 1.5–2.0 in snout; upper jaw 28–35% HL. Nasal fossa and broad areas anteriorly and laterally atop snout almost entirely naked; underside of snout naked except along anterolateral margins where scales broadly overlap edge; underside of head behind mouth and mandibular rami scaly; short triangular

spinules on body scales in irregularly quincunx to widely divergent rows. Light organ long, extends forward to near isthmus, Group IV. Ground color brownish to grayish, irregular darker blotches over dorsal portions of body, silvery ventrally; fins dark or dusky; mouth whitish, gill cavities, gular and branchiostegal membranes, and jaws dark dusky; 1D black along leading edge, dark on basal half or so, V and A blackish distally. Attains at least 326 mm TL. (Adapted from Okamura 1970, with additions from current material.)

DISTRIBUTION.— Known from East China Sea e. of Amami Is. (Ryukyu Islands) and Taiwan (NET, SWT, and SCS) in depths between about 100 and 600 m. Most abundant in 100–400 m.

REMARKS.— *Coelorinchus formosanus* is the most abundant grenadier species in Taiwan in depths less than 600 m (Wu 2002). Among the Group IV species of *Coelorinchus* of Taiwan, it is alone in having a scaly posterior underside of head. Okamura (1970:151) synonymized without comment *C. intermedius* Chu and Lo, 1963 and *C. abbreviatus* Chu and Lo, 1963 with *C. formosanus*. Xiong et al. (1988:148), however, considered *C. intermedius* as distinct, based on lesser amounts of scaly areas under the head and below the nasal fossa in the latter species. We have not been able to verify this with comparative material. They also provided no comment on the status of *C. abbreviatus*, suggesting agreement with Okamura's assessment of the nominal species.

Coelorinchus fuscigulus Iwamoto, Ho, and Shao, 2009

Coelorinchus fuscigulus Iwamoto, Ho, and Shao, 2009:40–45, figs. 1–2 (holotype ASIZP 70169, 74.8 mm HL, 322 mm TL; NET, Da-xi, 24.94°N, 121.9°E; 9 paratypes NET and East China Sea).

Coelorinchus cylindricus (non Iwamoto and Merrett, 1997): Shao et al., 2008: table 2 (listed, 1 spec. NET, 400–600 m).

MATERIAL EXAMINED.— All type specimens as listed in original description (Iwamoto et al., 2009). ASIZP 70169 (holotype, 74.8 HL, 322 TL), Da-xi; ASIZP 63249 (1, paratype, 56.1 HL, 233 TL), Da-xi; ASIZP 66922 (1, paratype, 66.2 HL, 286 TL), CP 248, 536 m; ASIZP 66973 (1, paratype, 72.7 HL, 293 TL), Nan-fang-ao; ASIZP 70168 (1, paratype, 77.1 HL, 301+ TL), Da-xi; CAS 228337 (2 paratypes, ex. ASIZP 70168, 66.9–74.1 HL, 302+–285+ TL), Da-xi; CAS 228338 (1, paratype, 66.9 HL, 266 TL), Nan-fang-ao; **East China Sea:** ASIZP 63193 (1, paratype, 52.2 HL, 228 TL) and CAS 224492 (1, paratype, ex. ASIZP 63193, 45.4 HL, 190 TL), Diao-yu-tai Archipelago, Yilan, Taiwan.

DISTINGUISHING FEATURES.— 1D II, 8–9; P i16–i18; GR-I (inner) 7–9 total; scales below mid-base 1D 5.5–6.5, below 2D 6.5–7.5; pyl.caeca 19–24. Snout produced and sharply pointed, length 36–41% HL, 1.4–1.7 times orbit; anterolateral margin of snout incompletely supported by bone; orbit 24–25% HL, upper jaw 26–30% HL. Nasal fossa scaled ventrally; underside of head naked except for overlapping scales on anterolateral snout margin; body scales with small, sharp spinules arranged in 10–13 parallel rows. Light organ Group IV of Iwamoto (1990); anterior fossa near isthmus, posterior before anus, no black stripe connecting the two. Rays of 2D well developed, about equal to opposite rays of anal fin. Overall color medium brown to grayish, but in fresh specimens silvery on ventral sides of head and trunk (bluish in preserved specimens); 8–11 prominent saddles on body; fins dusky to blackish; lips and jaws pale; branchiostegal region blackish. Attains at least 322 mm TL.

DISTRIBUTIONS.— Known only from NET and East China Sea in Diaoyutai Archipelago, Taiwan, in approximately 600 m.

REMARKS.— *Coelorinchus fuscigulus* was previously confused with *C. cylindricus*, a species known only from the holotype taken off New Caledonia, but that species has a complete bony support of the anterolateral snout margin. Among the Taiwan members of the genus, *C. fuscigulus* is

most similar to *C. brevirostris*, *C. cingulatus*, and *C. hubbsi*. The body markings easily distinguish the species from *C. brevirostris* and *C. hubbsi*; the blackish branchiostegals that contrast strongly with the pale gular membrane, the fully blackish 1D, and lack of an elongated 1D spinous ray distinguish it from *C. cingulatus*.

***Coelorhynchus hexafasciatus* Okamura, 1982**

Figure 6.

Coelorhynchus hexafasciatus Okamura in Okamura, Amaoka and Mitani, 1982:173, pl. 104 (Holotype: BSKU 30443; Kyushu-Palau Ridge, 26°45.0'N, 135°19.0'E, 336 m; 31 paratypes from Kyushu-Palau Ridge).

MATERIAL EXAMINED.— ASIZP 71202 (1, 133.3 mm HL, 494+ mm TL), Da-xi.

DISTINGUISHING FEATURES.— 1D II,9; P i17–18; V 7; GR-I (inner) 8; GR-II (outer/inner) 7/9; scale rows below 1D origin 7.5, below midbase 1D 5.5, below 2D origin 6. Snout conical, 40% HL; terminal scute rather blunt; anterolateral margin of snout incompletely support by bone; orbit 23% HL, 1.8 in snout length; mouth large, upper jaw 31% HL; posterior end of rictus scarcely restricted by a lip fold. Premaxillary teeth arranged in wide tapered band; outer series distinctly enlarged. Light organ restricted as a short naked streak before anus. Underside of head completely naked except for lower preopercle; nasal fossa scaled ventrally. Body scales large, adhered, covered with keel-like spinules in 7 widely divergent rows. Second spinous ray of 1D not elongated; 2D poorly developed throughout its length. About 6 dark saddles dorsally on trunk and tail; gill membrane blackish posteriorly; fins generally dark, but outer V ray somewhat paler. Attains at least 70 cm TL.

DISTRIBUTIONS.— Known from the Kyushu-Palau Ridge, s. Japan, and the East China Sea off Taiwan, in about 340–1320 m.

REMARKS.— This species may be confused with *C. sheni* (known only from Taiwan), but the two are readily distinguished by squamation on the head (underside of head mostly naked in *C. hexafasciatus* vs. completely scaled in *C. sheni*). The specimen herein reported represents the first record of the species from Taiwanese waters. The species was originally described from the Kyushu-Palau Ridge, but no additional specimens had been reported after the original description.

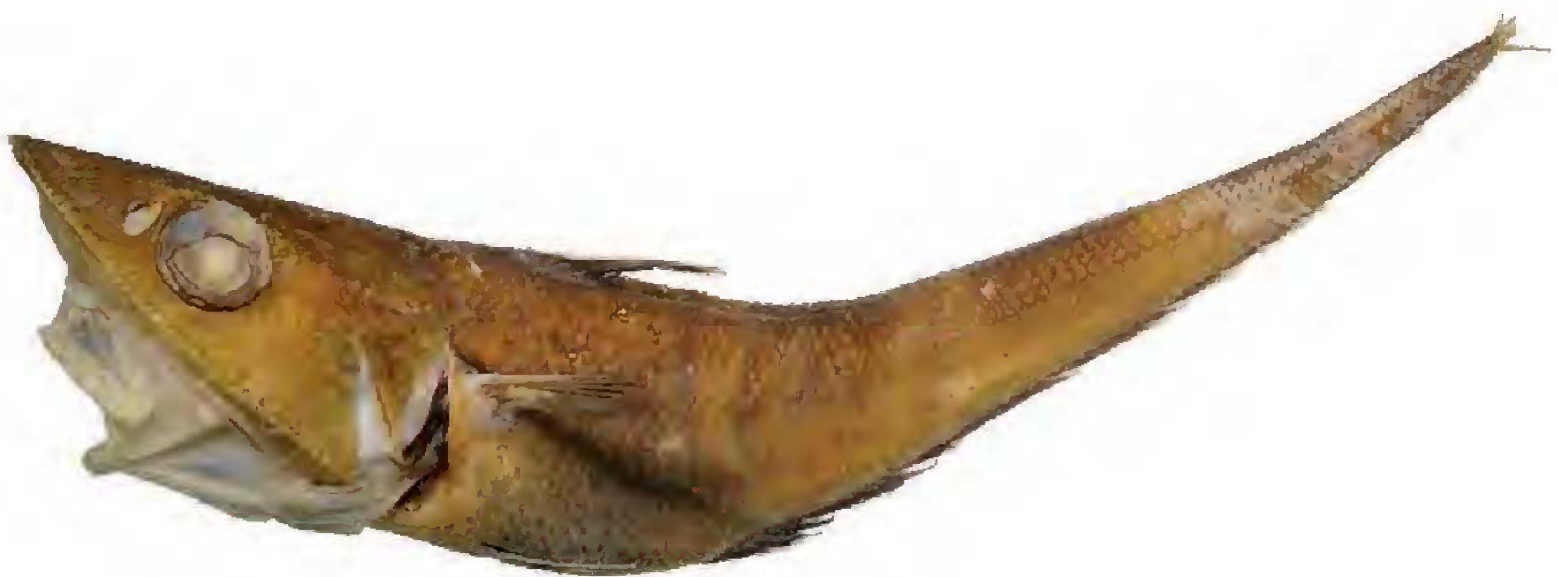


FIGURE 6. *Coelorhynchus hexafasciatus* Okamura, 1982. ASIZP 71202, 494+ TL, preserved. Photograph by N. Nakayama.

***Coelorinchus hubbsi* Matsubara, 1936**

Coelorhynchus hubbsi Matsubara, 1936:358 (holotype, FAKU. Owase, Mie-ken, Japan, 100–200 fm [about 183–366 m]).— Okamura *in* Okamura et al., 1982:166 (photograph of fresh specimen), 169 (comparison with *C. matsubarai*).

Coelorinchus hubbsi: Okamura *in* Masuda et al., 1984:96, pl. 82–L (photograph).— Shen et al., 1993:169.— Shao et al., 2008: table 2 (2 spec., NET, 100–400 m).

Coelorinchus hubbsi: Chiou et al., 2004b:37, 47 (in key, list).

MATERIAL EXAMINED (2 spec.).— **NET**: ASIZP 63189 (1, 260 TL), Diao-yu-tai; ASIZP 64536 (1, 162 TL), Diao-yu-tai.

DISTINGUISHING FEATURES.— 1D II, 8–10; P i15–i18; GR-I (inner) 8–10 total; scales below midbase 1D 4.0–4.5, below 2D 5.5–6.5; pyl.caeca 20–28. Snout produced and sharply pointed, length 38–45% HL, 1.26–1.65 times orbit; anterolateral margin of snout incompletely supported by bone; orbit 26–32% HL, upper jaw 22–27% HL. Nasal fossa scaled ventrally; underside of head naked except for overlapping scales on anterolateral snout margin; body scales with slender, sharp spinules, arranged in slightly divergent to subparallel rows. Light organ long, extending forward nearly to isthmus, Group IV of Iwamoto (1990). Rays of 2D well developed, about equal to opposites of anal fin. Ground color grayish, silvery on sides of head and trunk; three dark longitudinal streaks on side of body; underside of head and abdomen densely peppered; fins blackish to light dusky; mouth and gill cavities blackish. Attains at least 260 mm TL.

DISTRIBUTIONS.— Known from s. Japan to ne. Taiwan; restricted in Taiwan to off a small island called “Fishing Island [Uotsuri-shima of the Senkaku Shoto],” at depths less than 400 m.

REMARKS.— This species has an apparently restricted distribution; it was not captured during the Japanese expeditions off the Kyushu-Palau Ridge (Okamura et al. 1982) and the Okinawa Trough (Okamura and Kitajima 1984). The prominent body stripes on this species distinguish it from all other Taiwan *Coelorinchus*.

***Coelorinchus japonicus* (Temminck and Schlegel, 1846)**

Macrurus japonicus Temminck and Schlegel, 1846:256, pl. 112, fig. 2, 2A–B (bays in provinces Oomura and Shimabara, Japan. Lectotype: RMNH 3476. Paralectotypes: RMNH D1405–1406 [2 stuffed]).

Coelorhynchus japonicus: Gilbert and Hubbs, 1916:178–179 (5 spec., 158–307 mm TL; Japan).— Okamura, 1970:183–186, pl. XL, text-figs. 78, 79 (93 spec., 138–656 mm TL; range given as “tropic and subtropic regions of Indo-western Pacific including southern part of Japan”).— Yatou *in* Okamura et al., 1982:181, photo 106, 353 (8 spec., 438–750 m TL, 300–700 m).

Coelorinchus japonicus: Okamura *in* Masuda et al., 1984:98, pl. 83–D.— Yatou *in* Okamura and Kitajima, 1984:231, photo 163, 367 (10 spec., 315–680 mm TL, 560–1000 m).— Xiong, et al., 1988:190–192, fig. 152 (4 spec., 275–373 mm TL; East China Sea, 490–716 m).— Iwamoto, 1990:162–163, fig. 378.— Shen et al., 1993:169 (descr.).— Kim et al., 2005:172 (Korea).— Shao et al., 2008: table 2 (3 spec., NET, 100–650 m).

Coelorinchus japonicus: Chiou et al., 2004b:36, 47 (in key, list).

MATERIAL EXAMINED (7 spec.).— **NET**: ASIZP 56349 (1, 292 TL), Da-xi; ASIZP 65567 (1, 370+ TL), Da-xi; ASIZP 63280 (2, 370–600 TL), Da-xi; ASIZP 70216 (2, 363–450 TL), Da-xi; CAS 214622 (1, 300 TL), Da-xi.

DISTINGUISHING FEATURES.— 1D II, 8–10; P i16–i20; GR-I (inner) 7–9 total; scales below midbase 1D 4.5–6.0, below 2D 5.5–7.5; pyl.caeca 41–60. Snout produced and sharply pointed, length 40–48% HL; anterolateral margin of snout completely supported by bone; orbit 22–30% HL, upper jaw 23–29% HL. Nasal fossa scaled ventrally; underside of head, including mandibular rami scaly; most head scales with single crestlike spinule row; body scales with broadly triangular

spinules lacking strong transverse buttresses, arranged in 3–7 slightly divergent, sharply crestlike rows. Head ridges stout, heavily spinulated. Light organ short, Group I of Iwamoto (1990). Ground color brownish to grayish, paler below, darker over abdomen and gill covers; gular and BR membranes pale, lips white, mouth and gill cavities blackish; fins blackish to light dusky. Attains at least 750 mm TL. (Description mostly after Okamura, 1970.)

DISTRIBUTION.— From s. Japan (including Japan Sea), East China Sea (Okinawa Trough), to ne. Taiwan; 100–1000 m, but most abundant off Japan between 300 and 600 m.

REMARKS.— A large species with a substantial vertical distribution. One of the few grenadiers recorded as occurring in the Japan Sea, although that record is questionable and must be verified (see Kim et al. 2009:113). Among the Taiwan *Coelorinchus* with short light organ immediately anterior to A origin, *C. japonicus* is distinguished by the combination of anterolateral snout margin completely supported by bone, scales on underside and top of head with spinules in one crestlike row, and body scales with broad spinules in 3–7 sharp crestlike rows.

Coelorinchus kamoharai Matsubara, 1943

Coelorhynchus kamoharai Matsubara, 1943:136, fig. 4 (holotype, FAKU 2498 [apparently lost], Kumano-Nada, Japan; paratypes, FAKU 1593–1596 [4], 2496 [1], and 4 other unnumbered lots of 1, 3, 3 and 2 specimens, respectively [apparently lost]).— Okamura, 1970:159–161, text-fig. 64, pl. I, fig. b (111 spec., 115–284 TL; s. Japan)

Coelorinchus kamoharai: Okamura in Masuda et al., 1984:97.— Iwamoto, 1990:164–165, fig. 382 (compiled).— Yatou in Okamura and Kitajima, 1984:221 (fig. 157 on p. 220), 365 (10 spec.; East China Sea [Okinawa Trough], s. Japan, Taiwan; 220–400 m).— Shen et al., 1993:169 (descr.).— Shao et al., 2008: table 2 (6 spec., NET, 100–650 m).

Coelorinchus kamoharai: Chiou et al., 2004b:47 (list).

MATERIAL EXAMINED (9 spec.).— **NET:** ASIZP 61336 (4, 158–211 TL), Da-xi; ASIZP 65796 (1, 176 TL), Da-xi; ASIZP 66336 (1, 221 TL), Nan-Fang-Ao; CAS 56041 (1, 152 TL), Dong-gang; NMMST-P (1, 172 TL), Hsiao-liu-chiu. **Other specimens:** ASIZP 67947 (1, 190 TL), Aurora, 269–277 m.

DISTINGUISHING FEATURES.— 1D II, 8–10; P i15–i19; GR-I (inner) 9–12 total; scale below midbase 1D 3.5–4.0, below 2D 4.5–5.0; pyl.caeca 7–13. Snout sharply pointed, length 31–37% HL, anterolateral margin snout incompletely supported by bone; orbit 24–29% HL; upper jaw 28–34% HL. Nasal fossa and broad areas anteriorly and laterally atop snout naked; underside of head naked except along anterolateral margin of snout where scales broadly overlap edge; underside of head covered with unpaired black papillae; spinules on body scales short, broad based, in irregularly quincunx order. Light organ long, extends forward to near isthmus, Group IV. Dorsum brownish gray with irregular darker blotches, remainder of body silvery; chest and area around periproct and anal-fin origin blackish or dark; fins dusky; median nasal process black; mouth and gill cavities white; gular and branchiostegal membranes heavily peppered, but underside of snout covered with hair-like black papillae. Attains at least 284 mm TL.

DISTRIBUTION.— Southern Japan, East China Sea, ne. Taiwan, and Philippines, in depths of 100–650 m. The Philippine specimen represents the southernmost record of the species.

REMARKS.— *Coelorinchus kamoharai* is closely similar to *C. multispinulosus*, *C. formosanus*, and *C. longissimus*, but differs from them in its body markings; in addition, *C. multispinulosus* has slender, dense scale spinules on body scales and sparse, paired papillae under the head, *C. formosanus* has scales posteriorly on underside of head; and *C. longissimus* has scale spinules arranged in definite rows, small scales on nasal fossa, and underside of snout almost immaculate. Five paratypes (FAKU 1593–1596 and 2496) were rediscovered by one or us (NN) from the FAKU collection.

***Coelorinchus kishinouyei* Jordan and Snyder, 1900**

Coelorhynchus kishinouyei Jordan and Snyder, 1900:376–377, pl. XX (holotype [unique], USNM 49395; Misaki, Japan).— Gilbert and Hubbs, 1916:170–172 (7 spec., 192–295 TL, Suruga Gulf, Japan).— Okamura, 1970:172–175, pl. XXXVI, text-fig. 71 (92 spec., 123–362 TL; s. Japan, 250–450 m).

Coelorinchus kishinouyei: Okamura in Masuda et al., 1984:97.— Iwamoto, 1990:167 (compiled).— Shen et al., 1993:169 (descr.).— Shao et al., 2008: table 2 (15 spec., NET, SCS, SWT, 227–1211 m).

Coelorinchus (Paramacrurus) kishinouyei: Chiou et al., 2004b:47, table 1 (listed).

MATERIAL EXAMINED (55 spec.).— **NET**: ASZIP 56351 (4, 109–267 TL), Da-xi; ASIZP 58020 (8, 109–232 TL), Da-xi; ASIZP 58266 (4, 139–158 TL), Da-xi; ASIZP 58633 (2, 105–110 TL), Da-xi; ASIZP 58647 (2, 186–199 TL), Da-xi; ASIZP 60245 (2, 168–248 TL), Da-xi; ASZIP 61049 (1, 181 TL), Da-xi; ASZIP 63148 (1, 160 TL), Da-xi; ASIZP 65082 (1, 181 TL), Da-xi; ASIZP 65645 (1, 256 TL), Da-xi; ASIZP 65654 (1, 309 TL), Da-xi; ASIZP 65655 (1, 222 TL), Da-xi; ASIZP 65656 (1, 222+ TL), Da-xi; ASZIP 65659 (1, 220 TL), Da-xi; ASIZP 65660 (1, 185+ TL), Da-xi; ASIZP 65991 (1, 152 TL), Da-xi; ASIZP 70662 (5, 103–160 TL), Da-xi; ASIZP 70696 (6, 150–212 TL), Da-xi; ASIZP 70732 (1, 210 TL), Da-xi; CAS 214461 (1, 240+ TL), Su-ao; CAS 214612 (2, 192+–213+ TL), Da-xi; CAS 224170 (2, 205–202+ TL), Da-xi. **SWT**: ASIZ 62158 (1, 216 TL), Dong-gang. **SWT**: ASIZP 65555 (1, 188 TL), CD 142, 227–335 m; ASIZP 65585 (1, 205 TL), CD 136, 998–1211 m; ASIZP 65596 (1, 205 TL), CD 141, 985–1110 m; ASIZP 70616 (1, 146 TL), Dong-gang; ASIZP 70660 (1, 210 TL), Dong-gang.

DISTINGUISHING FEATURES.— 1D II, 8–10; P i15–i19; GR-I (inner) 9–10 total; scales below midbase 1D 3.5–4.0, below 2D.5–4.5; pyl.caeca 19–26. Snout sharply pointed, sides gently convex, tipped with a blunt scute, length 33–45% HL, anterolateral margin snout completely supported by bone; orbit 31–38% HL; upper jaw 23–29% HL. Nasal fossa and underside of head naked; spinules on body scales short, conical, in 8–17 parallel to slightly divergent rows. Light organ short, extends forward only to base of pelvic fins, Group II. Dorsum brownish, belly blackish, rest of body silvery, a large ($\frac{2}{3}$ orbit diameter) ocellated dark blotch above pectoral fin; underside of head densely peppered; mandibular rami and gill membranes blackish; fins generally dusky, second 1D spine and tips of rays black; mouth and gill cavities whitish. Attains at least 362 mm TL.

DISTRIBUTION.— Off s. Japan, South China Sea, and Taiwan (NET, SWT) in 200 m to more than 600 m

REMARKS.— *Coelorinchus kishinouyei* was strangely not recorded by Okamura and Kitajima (1984) from the Okinawa Trough, where it would be expected owing to its presence in s. Japan and Taiwan. In this regard, the distribution is similar to that of *C. hubbsi*. It is relatively abundant in landings at Da-xi in ne. Taiwan. This highly distinctive species is closely similar to *C. jordani*, which has a much smaller pectoral blotch and a longer light organ that extends well forward of the pelvic bases and onto the chest. The Taiwan specimens of *C. kishinouyei* appeared to have a slightly longer snout, smaller orbit, darker overall coloration with little or no silvery, with anal fin black overall, and blotch above pectoral fin more obscure and lacking pale outer ring (i.e., not ocellated).

***Coelorinchus leptorhinus* Chiou, Shao and Iwamoto, 2004**

Coelorinchus leptorhinus Chiou, Shao and Iwamoto, 2004a:299, figs. 1–3 (holotype, ASIZP 061344 and 23 paratypes, Da-xi, ne. Taiwan, 24°54.63'N, 122°03.49'E, 400–600 m).

Coelorinchus leptorhinus: Shao et al., 2008: table 2 (23 spec., NET, SWT, 100–650 m).

MATERIAL EXAMINED (54 spec.).— **NET**: ASZIP 58636 (1, 146 TL), Da-xi; ASIZP 58648 (2, 285–311 TL), Da-xi; ASIZP 60246 (1, 192 TL), Da-xi; ASIZP 60247 (1, 310 TL), Da-xi; ASIZP 61344 (1, holotype, 800 TL), Da-xi; ASIZP 61345 (1, paratype, 380 TL), Da-xi; ASIZP 61346 (10,

paratype, 142–176 TL), Da-xi; ASIZP 61347 (2, paratypes, 480–640 TL), Da-xi; ASIZP 64288 (1, 400 m, 146 TL), Da-xi; ASIZP 65569 (1, 567 TL), Da-xi; ASZIP 65571 (1, 407 TL), Da-xi; ASIZP 65642 (1, 370 TL), KSD sta.4; ASZIP 65646 (1, 230+ TL), Da-xi; ASZIP 65647 (1, 308 TL), KSD sta.4; ASZIP 65649 (1, 261 TL), KSD sta.; ASIZP 65781 (1, 346 TL), Da-xi; ASIZP 66253 (1, 352 TL), Da-xi; ASIZP 66917 (2, 212–224 TL), CP 248, 526 m; ASIZP 66939 (1, 133 TL), Da-xi; ASIZP 70214 (2, 334–394 TL), Da-xi; ASIZP 70252 (1, 147 TL), Da-xi; ASIZP 70692 (18, 200–375 TL), Da-xi. **SWT:** ASIZP 66405 (1, 240 TL), Dong-gang; ASIZP 65628 (1, 546 TL), CD 233, 448–526 m.

DISTINGUISHING FEATURES.— 1D II, 8–9; P i17–i18; GR-I (inner) 6–8 total; scales below mid-base 1D 5.5–7.5, below 2D 5.5–7.5; pyl.caeca 42–48. Snout long, narrow, pointed in lateral view, tip rounded, length 39–46% HL, anterolateral margin of snout completely supported by bone; orbit 16–19% HL; upper jaw 26–29% HL. Nasal fossa scaly, underside of snout naked, but finely scaled posteriorly on head; spinules on body scales in 5–8 sharp, slightly divergent ridge rows. Light organ short, Group II of Iwamoto (*in* Cohen et al. 1990); anus removed from A origin. Ground color brown, bluish on belly and halfway onto chest; underside of head, mouth, and gill cavities dark; fins generally dusky to blackish. Attains more than 850 mm TL.

DISTRIBUTION.— Apparently endemic to Taiwan (NET, SWT, SCS). The species is most abundant in 300–400 m off s. Taiwan and 400–800 m in ne. Taiwan.

REMARKS.— Shen et al.'s (1993) record of *C. tokensis* was a misidentification of *C. leptorhinus*. The species is abundant in the bycatch of the deepwater trawl fisheries off Da-xi (NET). It is most closely similar to the Philippines species *C. macrorhynchus* Smith and Radcliffe, 1912 in having a notably long snout, long jaws, relatively long barbel, and similar light organ. The main differences between the two species lie in *C. leptorhinus* having the underside of snout naked and having a slightly shorter snout (preoral length 35–40% HL cf 40–45%).

***Coelorinchus longissimus* Matsubara, 1943**

Coelorhynchus longissimus Matsubara, 1943:140, fig. 5 (holotype, FAKU 1592 [apparently lost]; Kumano-Nada, Japan).— Okamura, 1970:165–168, pl. XXXV, text-fig. 67 (48 spec., 200–357 mm TL; s. Japan, 280–400 m).

Coelorinchus longissimus: Okamura *in* Masuda et al., 1984:97, pl. 82–K (compiled).— Yatou *in* Okamura and Kitajima, 1984:223, 366, fig. 159 (5 spec., 175–325 mm TL; Okinawa Trough).— Shao et al., 2008: table 2 (3 spec., NET, SWT, 100–650 m).— Kim et al., 2005:172 (Korea; compiled).

Coelorinchus longissimus: Nakabo, 2003:430 (compiled).— Chiou et al., 2004b:43–44, fig. 10 (2 spec., NET, SWT).

MATERIAL EXAMINED (9 spec.).— **NET:** ASIZP 61337 (1, 202 TL), Da-xi; ASIZP 70695 (2, 212–235 TL), Da-xi. **SWT:** ASIZP 57602 (1, 182 TL), Dong-gang; ASIZP 61338 (1, 262 TL), Dong-gang); ASIZP 70614 (1, 165 TL), Dong-gang. **Other material: Philippines:** ASIZP 68091 (1, 84 TL), Aurora, 184–200; ASIZP 68423 (2, 100–103 TL), Aurora, 184–200 m.

DISTINGUISHING FEATURES.— 1D II, 8–10; P i16–i20; GR-I (inner) 6–9 total; scales below midbase 1D 3.0–4.5, below 2D 3.5–4.5; pyl.caeca 16–23. Snout sharply pointed, length 42–45% HL, anterolateral margin snout incompletely supported by bone; orbit 24–27% HL; upper jaw 23–28% HL. Most of nasal fossa and broad areas atop snout naked; underside of head naked except along anterolateral margin of snout where scales broadly overlap edge; spinules on body scales short, weak, slender in 6–14 parallel to slightly divergent rows. Light organ long, extends forward to near isthmus, Group IV of Iwamoto (*in* Cohen et al. 1990). Dorsum gray with faint irregular blotches, remainder of body silvery; fins dusky, 1D with blackish membrane behind long spinous ray; median nasal process black; mouth white, gill cavities blackish; gular and branchiostegal

membranes heavily peppered; underside of snout clear, mostly lacking melanophores except along outer margins. Attains at least 357 mm TL.

DISTRIBUTION.— Pacific coast of s. Japan from Suruga Bay s. into the East China Sea (Okinawa Trough), ne. Taiwan, the South China Sea off Taiwan, and in the Philippines, in 280–400 m.

REMARKS.— This species is closely similar to *C. kamoharai*, differing only in the slender scale spinules arrayed in many divergent rows (as compared with short broad spinules in quincunx pattern) and paler, slightly different pattern of blotches on the body.

***Coelorinchus macrochir* (Günther, 1877)**

Figure 7.

Macrurus macrochir Günther, 1877:438 (holotype, BMNH 1887.12.7.123; off “Inoshima” [= Enoshima], Japan, *Challenger* sta. 232, 345 fm [631 m]).

Abyssicola macrochir: Goode and Bean, 1896:417 (compiled, type-species for new genus *Abyssicola*).— Gilbert and Hubbs, 1916:183–184–186 (36 spec., 91–634 mm TL; Pacific coast of Japan, 129–437 fm [236–799 m]).— Okamura, 1970:145–148, pl. XXXII, text-fig. 58 (136 spec., 173–680 mm TL; Japan: Hokkaido to East China Sea off Kagoshima Prefecture).— Okamura *in* Masuda et al., 1984:96, pl. 82–G (compiled).— Okamura *in* Okamura and Kitajima, 1984:221, 364 (1 spec., 590 mm TL; Okinawa Trough, 820 m).— Nakabo, 2002:429 (compiled).

Coelorhynchus (*Abyssicola*) *macrochir*: Gilbert and Hubbs, 1920:425 (in key).

Coelorinchus macrochir: Iwamoto, 1990:171 (compiled).— Shao et al., 2008: table 2 (2 spec., NET, 100–650 m; first record from Taiwan).— Honma et al., 2008:65–74 (Japan Sea).— Kim et al., 2009:110–112, fig. 5, table 2 (East Sea [Japan Sea], Korea).

MATERIAL EXAMINED (2 spec.).— **NET**: ASIZP 65574 (1, 424 TL), Da-xi; ASIZP 66972 (1, 570 TL), Da-xi.

DISTINGUISHING FEATURES.— 1D II, 9–11; P i16–i20; GR-I (inner) 10–12 total; scales below midbase 1D 4.5–6.0, below 2D 5.5–7.0; pyl.caeca 42–48. Snout rather bluntly conical to rounded

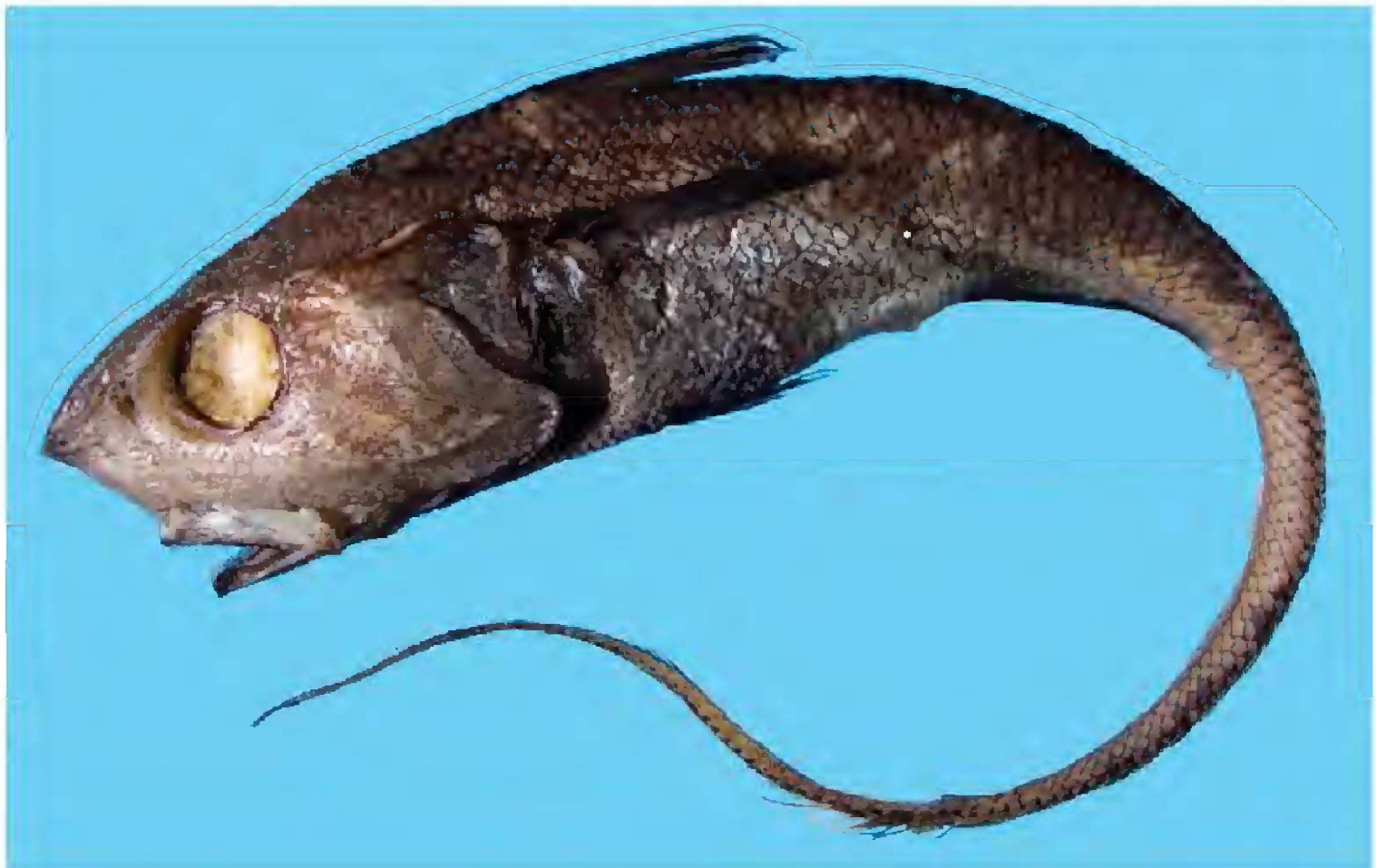


FIGURE 7. *Coelorinchus macrochir* (Günther, 1877). ASIZP 55972, 570 mm TL, preserved.

in lateral profile, length 29–36% HL, anterolateral margin of snout incompletely supported by bone; a distinct curve in anterior portion of suborbital ridge; orbit 27–33% HL; mouth relatively large, upper jaw 34–42% HL. Nasal fossa and underside of head scaly; spinules on body scales short, broad, in 4–9 widely divergent rows. Vent about midway between pelvic-fin base and anal-fin origin; naked fossa of light organ close before vent (Group II of Iwamoto, 1990). Ground color brown, bluish ventrally on trunk; mouth and gill cavities blackish; fins dusky to blackish. Attains at least 680 mm TL.

DISTRIBUTION.— Pacific coast of Japan (Hokkaido to Kyushu off Kagoshima), s. Okhotsk Sea, East China Sea (including Okinawa Trough), Japan Sea off Niigata, ne. Taiwan, and the Philippines, in 235–830 m.

REMARKS.— Shao et al. (2008: table 2) first recorded the species from Taiwan based on the two specimens listed above; they represent the southernmost record (lat. 24.8°N) of the species. Most previous workers have included *Coelorinchus macrochir* in its own genus, *Abyssicola* Günther, based primarily on its dentition: short conical teeth in three series in premaxilla, in two series in dentary. Okamura (1970:143–144) provided a lengthy diagnosis that readily differentiated the species from the 14 then-known Japanese species of *Coelorinchus*. However, when viewed on a worldwide basis of more than 100 species in the genus, the diagnostic characters enumerated by Okamura are shared by one or more species of *Coelorinchus* sensu lato and thus fail to differentiate *Abyssicola*. Fukui et al. (2010) conducted a detailed study of the eggs and larvae of *C. kishinouyei*, and using DNA nucleotide sequences, provided a (*op. cit.* fig. 3) phylogenetic tree which showed *C. macrochir* deeply nested within other Japanese *Coelorinchus*, with its sister group being *C. anatirostris/productus* (which they considered as synonyms: see Remarks under *C. productus*).

***Coelorinchus* cf. *macrorhynchus* [sensu Smith and Radcliffe, 1912]**

Figure 8.

MATERIAL EXAMINED.— **SWT:** ASIZP 65531 (1, 73.0 mm HL, 222 mm TL), CD 138, 441 m.

Distinguishing feature.— 1D II 9; P i18–i19; GR-I (inner) 2+6, GR-II (outer/inner) 0+6 / 1+7; scales below midbase 1D 4.5, below 2D 6.5, lateral-line scales over distance equal to pre-D length 47. Snout sharply pointed, slender and spear-shaped in dorsal view, length 51% HL; anterolateral margin of snout completely supported by bone; orbit 23% HL, 2.2 in snout length, upper jaw 23% HL; nasal fossa densely scaled anteriorly and ventrally; underside of head almost fully scaled (scales with 1–3 short rows of spinules). Light organ group II of Iwamoto (1990), fossa narrow and short, not extending to pelvic-fin bases. Anus separated from A origin by 2 or 3 scale rows. Spinules on body scales blade-like in 3–6 sharp, divergent, ridgelike rows, closely overlapping, with height increasing abruptly with posteriormost spinule much larger than anterior ones. Ground color brownish (somewhat faded), bluish over abdomen but not on chest; mouth and gill cavity dark; most fins dark dusky to blackish. Attains more than 44 mm TL.

DISTRIBUTION.— Broadly distributed from Philippines to e. and w. coasts of Australia, in 485–1107 m. In Taiwan, the single specimen was collected in 441 m.

REMARKS.— This single juvenile was captured in the same haul as two specimens (ASIZP 65523, 250–265 mm TL) that we identified as *C. smithi*. It differed from those specimens in having a more slender and longer snout (orbit 2.2 into snout, cf. 1.3–2.1 in *C. smithi*), slightly narrower internasal and interorbital widths (16% HL and 18% HL, respectively, cf. 17–19% and 19–23% in *C. smithi*) and the nasal fossa was almost fully covered with small scales antero-ventrally (naked to sparsely covered in *C. smithi*). The differences are so slight that we are uncertain whether they simply represent individual variation; thus, our identification must be considered as tentative. The presence of this species in Taiwan waters should not be surprising, however, as it was originally



FIGURE 8. *Coelorhynchus* cf. *macrorhynchus* [sensu Smith and Radcliffe, 1912]. ASIZP65531, 222 mm TL. A. lateral view. B. dorsal view of head. C. ventral view of head.

described from captures in the Philippines in the Verde Island Passage off sw. Luzon. If confirmed, this specimen represents the first record of the species from Taiwan.

Coelorhynchus multispinulosus Katayama, 1942

Coelorhynchus multispinulosus Katayama, 1942:332 (holotype, NSMT-P 18224; Tsuiyama Market, Yogo Pref., Japan [Japan Sea]).— Okamura, 1970:156–158, pl. XXXIII, text-fig. 63 (89 spec., 154–378 mm TL; s. Japan, Japan Sea, East China Sea, 150–300 m).

Coelorhynchus multispinulosus: Okamura in Masuda et al., 1984:97, pl. 82–H (compiled).— Yatou in Okamura and Kitajima, 1984:223, fig. 158 (p. 222), 365 (7 spec., 230–325 mm TL; Okinawa Trough in 146–200 m).— Iwamoto, 1990:174–175, fig. 398 (compiled).— Shen et al., 1993:170 (descr.).— Kim et al., 2005:173 (Korea; compiled).— Shao et al., 2008: table 2 (11 spec., NET, 100–650 m).

Coelorhynchus multispinulosus: Nakabo, 2002:430 (compiled).— Chiou et al., 2004b:37, 47 (in key, list).

MATERIAL EXAMINED (46 spec.).— **NET**: ASIZP 57306 (1, 202 TL), Da-xi; ASIZP 58021 (2, 179–274 TL), Da-xi; ASIZP 58635 (4, 158–255 TL), Da-xi; ASIZP 58699 (2, 179–214 TL), Da-xi; ASZIP 61084 (6, 210–245 TL), Da-xi, 100 m; ASIZP 61104 (1, 135 TL), Da-xi, 50 m; ASIZP 61333 (1, 236 TL), Da-xi; ASIZP 65174 (1, 227 TL), Da-xi; ASZIP 65651 (1, 180 TL), KSD sta. 4; ASZIP 65653 (1, 189 TL), KSD st. 4; ASIZP 66924 (2, 220–255 TL), CP 250, 220 m; ASIZP 61047 (3, 195–230 TL), Da-xi; ASIZP 70663 (13, 195–245 TL), Da-xi; NMMSTP 0183 (2, 208–220 TL), Da-xi; CAS 214597 (6), Da-xi. **NT**: ASZIP 55477 (1, 203 TL), Ye-liou; ASIZP 61215 (1, 215 TL), Jim-shan, 100 m.

DISTINGUISHING FEATURES.— 1D II, 8–10; P i13–i17; GR-I (inner) 7–10 total; scales below midbase 1D 3.5–4.5, below 2D 3.5–4.5; pyl.caeca 11–20. Snout sharply pointed, length 40–45% HL, scattered paired papillae on underside, anterolateral margins incompletely supported by bone; orbit 22–27% HL; upper jaw 27–31% HL. Most of nasal fossa and broad areas atop snout naked; underside of head naked except along anterolateral margin of snout where scales broadly overlap edge; spinules on body scales weak, slender, in quincunx order. Light organ long, extends forward to near isthmus, Group IV of Iwamoto (1990). Dorsally on body and nape grayish with prominent vermiculations and blotches that extend below lateral midline, laterally mostly silvery, blackish ventrally on trunk, thorax, jaws, and gill membranes; fins dusky to blackish, 1D with blackish membrane behind long spinous ray; mouth white, gill cavities blackish; underside of snout with scattered paired papillae. Attains at least 378 mm TL.

DISTRIBUTION.— Pacific coast of s. Japan to ne. Taiwan, Japan Sea, and East China Sea (Okinawa Trough), in depth less than 400 m. Most abundant in depths less than 200 m.

REMARKS.— *Coelorinchus multispinulosus* is one of the most abundant grenadier in s. Japan and one of only a few grenadier species known to occur in the Japan Sea (Kim, I.S. et al. 2005; Kim, S.Y. et al. 2009). Its normal depth distribution is also one of the shallowest of all grenadiers from the general region. Its body marking is unique among the Taiwan members of the genus.

***Coelorinchus cf. notatus* [sensu Smith and Radcliffe, 1912]**

Figure 9.

MATERIAL EXAMINED.— NMMB-P11958 (90++ mm TL, large portion of tail missing, 35.5 mm HL); Taiwan; Nan-fang-ao; ca. 280 m.

DISTINGUISHING FEATURES.— 1D II, 9; P i16; GR-I (inner) 1+1+6, 8 total; scales below midbase 1D 3.5, below 2D 5.5; pyl.caeca 25. Snout sharply pointed in lateral view, sides gently convex in dorsal view, tipped with a short, broad scute, length 43% HL, anterolateral margin snout completely supported by bone; orbit 28% HL; upper jaw 23% HL. Nasal fossa and underside of head naked; spinules on body scales short, conical, in 5 or 6 almost parallel rows. Light organ short, extends forward slightly anterior to base of pelvic fins, Group II. Belly bluish, ventral aspects of body tail pale; a small (pupil width) ocellated black blotch above pectoral fin; underside of head almost entirely pale to whitish; mandibular rami and gill membranes pale; fins generally dusky, second 1D spine and tips of rays blackish; mouth and gill cavities blackish, but lips pale.

DISTRIBUTION.— Taiwan off Nan-fang-ao (NET) in about 280 m.

REMARKS.— This single damaged specimen (tail mostly broken off, scales almost entirely missing on body and head) belongs amongst those *Coelorinchus* species that Gilbert and Hubbs (1920:446) included under the subgenus *Paramacrurus* Bleeker. Most of the species in this group have a dark blotch above the base of the pectoral fin, an acute snout slightly longer than diameter of orbit, lateral margins of snout fully supported by bone, snout with convex lateral profile (viewed dorsally), anus removed by a short distance from anal-fin origin, and light organ moderately developed with dermal window extending forward between pelvic-fin bases (and beyond in some species). The subgenus includes *C. kishinouyei* and *C. jordani* from Japan, and at least nine others from the Philippines-East Indies regions, including *C. notatus*, *C. maculatus*, *C. velifer*, *C. sexradiatus*, *C. triocellatus*, *C. dorsalis*, *C. macrolepis*, *C. argus*, and *C. thurla*. The Taiwan specimen follows very closely the original description and illustration of *C. notatus* Smith and Radcliffe, 1913, as well as the more-extensive description provided by Gilbert and Hubbs (1920:462–465), who in a footnote (*op. cit.* p. 464) stated that none of Radcliffe's "smaller specimens are true *notatus*." Thus, the species is known only from the holotype. NMMB-P11958 differs from *C. notatus*



FIGURE 9. *Coelorinchus cf. notatus* [*sensu* Smith & Radcliffe, 1912], NMMB-P11958, 90+ mm TL.

in having a smaller pectoral blotch, which covers only four diagonal scale rows (cf. six in *C. notatus*) and a snout with a straight dorsal profile (cf. slightly concave). Gilbert and Hubbs (1920:465) stated that “the belly is blackish only in advance of the ventrals,” but Radcliffe (1913:137) stated, “belly with blackish shades showing through scales.” In NMMB-P11958, the entire underside of the trunk is dark bluish, from the gill membranes to beyond the anal-fin origin. The Taiwan specimen appears to have more saddle markings than does *C. notatus*. A broad dark saddle extends from before the mid-base of 1D to slightly beyond the origin of 2D. This saddle extends one or two scale rows below the lateral line, about to the mid-lateral line of the body; it is not as dark as the pectoral blotch or the short (5 or 6 rows wide) more-posteriorly situated saddle from which it is separated by a pale gap occupying three scale rows wide. A third, longer saddle that does not extend to the lateral line follows a pale gap of three scale rows; this shallow saddle is about 12 scales long and 2.5 to 3 scales deep. A fourth short saddle appears to be developed, although the specimen is so damaged that only parts of the integument remain and the precise limits of the marking could not be confidently ascertained. The second and fourth saddles are about in the positions shown for the two saddle marks in the original illustration of the *C. notatus* (Radcliffe, 1913: pl. 30, fig. 3), which does not show the intervening saddles seen in NMMB-P11958. The relatively poor condition of the Taiwan specimen does not allow us to confidently assign the specimen to a species. A judgement awaits the collection and study of additional, better-preserved specimens.

Coelorinchus parallelus (Günther, 1877)

Macrurus parallelus Günther, 1877:439 (syntypes, BMNH 1887.12.7.65–68[4], 1887.12.7.69 [1]; MNHN 1890–0125 [ex BMNH] [1]; NMI block reg. no. 114.1899 [1]; off Inoshima, Japan, *Challenger* sta. 232, 345 fm [631 m]. Specimens [4] from New Zealand and Kermadec Islands subsequently renamed *C. kermadecus* Jordan and Gilbert, 1904).

Coelorhynchus parallelus: Okamura, 1970:198–200, pl. XLIII, text-fig. 86 (2 spec., 400–450 mm TL; Japan).

Coelorinchus parallelus: Kyushin et al., 1977:42 Okamura in Masuda et al., 1984:98–99, pl. 83–3 (compiled).—Yatou in Okamura and Kitajima, 1984:245, fig. 171 (p. 244), 370 (9 spec., 275–480 mm TL; Okinawa Trough, in 650–990 m).—Iwamoto, 1990:178–179, fig. 404 (compiled).—Iwamoto and Merrett, 1997:500–502, fig. 12 (3 spec., New Caledonia region, 412–970 m).—Iwamoto et al., 1999:52.—Merrett and Iwamoto, 2000:746–747, fig. 12 (5 spec., Vanuatu, Norfolk Ridge, Lord Howe Rise, in 764–1124 m).—Shen et al., 1993:170 (descr.).—Shao et al., 2008: table 2 (3 spec., SWT, 100–650 m).

Coelorinchus parallelus: Chiou et al., 2004b:36, 47 (in key, list).

Coelorinchus commutabilis: Shao et al., 2008: table 2 (1 spec., SCS, 731 m; first record from Taiwan).

MATERIAL EXAMINED (6 spec.).—**NET**: ASIZP 65570 (1, 635+ TL), KSD sta.3; ASIZP 70690 (1, 380 TL), Da-xi. **SWT**: ASIZP 65542 (1, 405 TL), CD 138, 441 m; ASIZP 65630 (1, 146 HL, 404 TL) and ASIZP 70271 (1, 430 TL), CD 230, 810–850 m; ASIZP 66108 (1, 350+ TL), OCP 301,

687 m. **SCS:** ASIZP 66785 (1, 62 HL, 210 TL) and CAS 224496 (ex ASIZP 66785) (1, 61 HL, 220 TL), CD 320, 731 m.

DISTINGUISHING FEATURES.— 1D II, 8–9; P i17–i18; GR-I (inner) 7–8 total; scales below midbase 1D 3.5–4.0, below 2D 4.5–5.5; pyl. caeca about 9. Snout long, sides converge in gentle curve towards sharp spinous scute at tip, length 42–48% HL, anterolateral margin snout incompletely supported by bone; orbit 23–27% HL; upper jaw 22–26% HL. Nasal fossa and underside of snout scaly; body scales large, spinules stout, broad-based, in 1–6 parallel rows; scales of head mostly with spinules arranged in single parallel ridge-row. Light organ short, scarcely visible before vent; Group I of Iwamoto (1990). Color brown, to grayish; mouth and gill cavities dark; fins dusky to blackish. Attains about 450 mm TL.

DISTRIBUTION.— Pacific coast of s. Japan to Taiwan, East China Sea, South China Sea, and sw. Pacific. In Taiwan, specimens were collected from NET and SWT in depths of 441–850 m.

REMARKS.— *Coelorinchus parallelus* has a reportedly disjunct distribution in the western Pacific. Its apparent absence from the Philippines and Indo-Australian Archipelago and its reported presence on oceanic elevations in the sw. Pacific is suspicious. Specimens from the latter area should be examined in greater detail to confirm their conspecificity with the type specimens. Among the Taiwan *Coelorinchus* species with a simple (Group I) light organ, *C. parallelus* can be distinguished by the combination of broad spinules on body scales arranged in 4–6 parallel rows and its incompletely supported anterolateral snout margin. The two Taiwan specimens previously reported as *C. commutabilis* by Shao et al. (2009) from the SCS are questionably recorded here as this species. In almost all features, they fall in well with *C. parallelus*, but the spinules on their body and head scales are more slender and lack the broadly transverse buttresses characteristic of *C. parallelus*. Also, the nasal fossa is sparsely scaled anteriorly and the snout viewed dorsally is somewhat broader and more convexly curved. That these SCS specimens are relatively small (210+–220+ mm TL) may account for the differences. A good size series is necessary to confirm these differences.

***Coelorinchus productus* Gilbert and Hubbs, 1916**

Coelorhynchus productus Gilbert and Hubbs, 1916:175–177, pl. 9, fig. 1 (holotype, USNM 76865; Suruga Gulf, Japan, 197–297 fm [360–543 m]; paratypes, CAS-SU 22977, USNM 76872, 76873).

Coelorinchus productus: Yatou in Okamura and Kitajima, 1984:233, fig. 166 (p. 232), 369 (3 spec., 210–270 mm TL; Okinawa Trough, 410–600 m).— Iwamoto, 1990:179–180, fig. 406 (descr.).— Shao et al., 2008: table 2 (3 spec., NET, SWT, 100–650 m).

Coelorinchus productus: Chiou et al., 2004b:44, fig.11 (2 spec., NET).

MATERIAL EXAMINED (5 spec.).— **NET:** ASIZP 61326 (1, 296+ TL), Da-xi; ASIZP 61327 (1, 221 TL), Da-xi; ASZIP 65573 (1, 333 TL), Da-xi; ASIZP 65644 (1, 239 TL), Da-xi; ASZIP 65648 (1, 241+ TL), Da-xi.

DISTINGUISHING FEATURES.— 1D II 8–10; P i16–i18; GR-I (inner) 6–8 total. Scales below midbase 1D 3.5–4.5, below 2D 4–6; pyl.caeca about 27. Snout sharply pointed, length 39–42% HL, 1.5–1.7 times orbit; anterolateral margin of snout completely supported by bone; orbit 26–29% HL, upper jaw 22–23% HL; nasal fossa scaled ventrally; underside of head naked except for occasional small patch below preopercle angle. Light organ group II of Iwamoto (1990), fossa narrow and short, not extending to pelvic-fin bases. Spinules on body scales daggerlike in 3–5 slightly divergent ridgelike rows, middle row strongest. Ground color grayish-brown, silvery ventrally, bluish over abdomen becoming blackish ventrally; mouth and gill cavity blackish; fins dusky to blackish. Attains about 310 mm TL.

DISTRIBUTION.— Pacific coast of s. Japan to ne. Taiwan in 271–651 m.

REMARKS.— *Coelorinchus productus* has been confused with the closely similar *C. anatirostris*, into which Okamura (1970:186) synonymized the species. However, Yatou (*in* Okamura and Kitajima, 1984:233) treated it as distinct, and Iwamoto (1990:130) and Nakabo (2002:434) provided characters by which the two species could be distinguished. Chiou et al. (2004b) used the specimens here listed to document the first record of the species in Taiwanese waters. In a recent paper, Fukui et al. (2010) re-synonymized *C. productus* with *C. anatirostris* based on examination of two specimens of the former and one of the latter, each collected in Suruga Bay. Their selected measurements and analysis of nucleotide sequences (16S rRNA) showed the two to be the same. However, their measurements do not wholly agree with those we took from our specimens of the two species. Aside from proportional measurements, which can sometimes be misleading because of individual variation, they mention no other character used to distinguish their specimens of each species. This raises the question of whether or not they actually had specimens of *C. productus* (or *C. anatirostris*). Obviously, this problem needs further investigation; in the meantime, we will continue recognition of both species based on characters here given.

***Coelorinchus sheni* Chiou, Shao, and Iwamoto, 2004**

Coelorinchus sheni Chiou, Shao and Iwamoto, 2004a:37–39, figs. 1–4 (holotype, ASIZP 061348; off Da-xi, ne. Taiwan, 24°54'63"N, 120°03'49"E, 400–650 m; paratypes: ASIZP 061232 [1], CAS 215541[1]).

Coelorinchus sheni: Shao et al., 2008: table 2 (3 spec., NET, SWT, 100–650 m).

MATERIAL EXAMINED (13 spec.).— **NET:** ASIZP 61348 (1, holotype, 420 TL), Da-xi; CAS 215541 (1, paratype, 427 TL), Da-xi; ASIZP 70292 (1, 535 TL), Da-xi; ASIZP 70210 (8, 135–377 TL), Da-xi. BSKU 116417 (1, 578 TL), Da-xi. **SET:** ASIZP 61232 (1, paratype, 937 TL), Lyu-dao.

DISTINGUISHING FEATURES.— 1D II 8–9; P i18–i19; GR-I (inner) 9–10 total. Scales below midbase 1D 4.5–5.0, below 2D 5–6; pyl.caeca about 27. Snout long, smoothly conical in lateral profile, narrow in dorsal view, its length 41–56% HL, about 2.0 times orbit; anterolateral margin of snout incompletely supported by bone; orbit 20–21% HL, its dorsal margin well below dorsal profile; upper jaw 30–37% HL; nasal fossa scaled anteriorly and ventrally; underside of head fully scaled. Light organ group II of Iwamoto (1990), fossa narrow and short, not extending to pelvic-fin bases. Spinules on body scales sharp, blade-like, in 5–7 slightly divergent, crestlike rows, middle row strongest. Ground color light brown, bluish over abdomen; about 5 prominent saddle marking interspersed with pale narrow bars from trunk to tip of tail; mouth and gill cavity blackish; fins dusky, but pelvic fins blackish except for white outer prolonged ray; margin of A blackish. Attains more than 937 mm TL.

DISTRIBUTION.— Known only from ne. and se. Taiwan in depths of about 100–650 m.

REMARKS.— *Coelorinchus sheni* appears to be confined to rough-bottom slopes of e. Taiwan where bottom trawls are ineffective; specimens were all captured by longline.

***Coelorinchus smithi* Gilbert and Hubbs, 1920**

Coelorhynchus smithi Gilbert and Hubbs, 1920:493–498, fig. 20 (holotype, USNM 78212; Indonesia ne. of Celebes, 298 fm [545 m]; 8 paratypes, Philippines and Indonesia).— Okamura, 1970:179–183, pl. XXXIX, text-figs. 75–77 (63 spec., 144–322 mm TL; s. Japan in 300–610 m).— Okamura *in* Okamura et al., 1982:171, 353, fig. 103 (p.170) (8 spec., 242.5–295 mm TL; Kyushu-Palau Ridge and Tosa Bay, in 300–610 m).

Coelorinchus smithi: Okamura *in* Masuda et al., 1984:98, fig. 83C (compiled).— Yatou *in* Okamura and Kitajima, 1984:231, 368, fig. 164 (p. 230) (5 spec., 235–385 mm TL; Okinawa Trough [East China Sea], in 400–600 m).— Shao et al., 2008: table 2 (8 spec., NET, SCS, SWT, 441–1110 m).

Coelorinchus smithi: Iwamoto and Williams, 1999:161–164, fig. 22 (10 spec., Java, n. and ne. Australia,

402–731 m).— Iwamoto and Graham, 2001:455, fig. 71 (1 spec., se. Australia, 740 m).— Nakabo, 2003:433 (compiled).— Chiou et al., 2004b:36, 47 (in key, list).

MATERIAL EXAMINED (7spec.).— **NET:** ASIZP 61330 (1, 316 TL), Da-xi; ASIZP 61331 (1, 291 TL), Da-xi. **SWT:** ASIZP 65523 (2, 250–265 TL), CD 138, 441 m; ASIZP 65594 (2, 230–255 TL), CD 141, 985–1110 m; ASIZP 58062 (1, 230+ TL), Tong-Sha Islands, SCS.

DISTINGUISHING FEATURES.—1D II 7–10; P i15–i19; GR-I (inner) 7–8 total; scales below mid-base 1D 3.5–4.5, below 2D 4.5–6.0; pyl.caeca 19–37. Snout sharply pointed, length 39–52% HL; anterolateral margin of snout completely supported by bone; orbit 24–30% HL, upper jaw 20–29% HL; nasal fossa usually sparsely scaled ventrally; underside of head almost fully scaled (scales with 1–3 short rows of spinules). Light organ group II of Iwamoto (1990), fossa narrow and short, not extending to pelvic-fin bases. Spinules on body scales blade-like in 3–7 sharp, divergent, ridgelike rows. Ground color grayish-brown, paler to silvery ventrally, bluish over abdomen but not on chest; mouth and gill cavity dark; most fins dark dusky to blackish. Attains more than 32 mm TL.

DISTRIBUTION.— Broadly distributed from s. Japan to Indonesia and Australia, in 300–750 m. In Taiwan, specimens have been collected between 441 m and 1110 m.

REMARKS.— Among the *Coelorinchus* of Taiwan, *C. smithi* is most similar to *C. leptorhinus*, *C. spinifer*, *C. macrorhynchus*, and *C. japonicus* in having the anterolateral snout margin completely supported by bone. It is distinguishable from *C. leptorhinus* in having underside of snout fully scaled (cf. mostly naked) and from *C. spinifer* in having notably stronger, larger scale spinules on body scales, arrayed in three divergent rows with the middle row notably larger, and by having the length of the 1D base entering 1.2 times into the 1D-2D interspace. It differs from *C. japonicus* in having a distinct, though short, naked fossa before the vent (lacking in *C. japonicus*), somewhat fewer scale rows below the midbase of 1D (3.5–4.5 vs. 4.5–6.0) and below 2D origin (4.5–6.0 vs. 5.5–7.5), fewer pyloric caeca (21–37 vs. 41–60), and narrower scale spinules (broad buttresses in *C. japonicus*). Differences from *C. macrorhynchus* are discussed in the description of that species.

Coelorinchus cf. *spinifer* [sensu Gilbert and Hubbs, 1920]

Coelorhynchus spinifer Gilbert and Hubbs, 1920:516–519, fig. 30 (holotype: USNM 78226, Gulf of Tomini, Sulawesi [Celebes], 762 fm [1440 m]).

Coelorinchus spinifer: Shao et al., 2008: table 2 (1 spec., SCS, 1098 m; first record from Taiwan).— Iwamoto et al., 2009:47–48, fig. 4A–B (descr. of Taiwan spec.)

MATERIAL EXAMINED (1 spec.).— **SCS:** ASIZP 66748 (1, 52 HL, 180 TL), CD 322, 1098 m.

DISTINGUISHING FEATURES.— 1D II, 11; P i16; GR-I 2+7 (inner); GR-II 1+7 (outer); scales below midbase 1D about 7, below 2D 6; lateral line scales over distance equal to predorsal length ca. 43. Snout sharply pointed, about twice orbit diameter, 45–52% HL; anterolateral margin of snout completely supported by bone; orbit 22–23% HL, internasal width 19%, interorbital 25%, orbit to preopercle 30%, postorbital 30%, upper jaw 22%; length 1D base 1.2 times into 1D-2D interspace; underside of head almost fully covered with tiny deciduous scales. Light organ group II of Iwamoto (1990), fossa narrow and short, not extending to pelvic-fin bases. Scales strong and prickly, spinules on body scales in 3 slightly divergent, ridgelike rows, middle row larger. Ground color brownish, blackish over abdomen, opercles, jaws, and gular and branchiostegal membranes; mouth and gill cavity black; most fins dusky, but P and V blackish, outer V ray pale. Attains at least 185 mm TL.

DISTRIBUTION.— Indonesia off Sulawesi and South China Sea off Taiwan in depths of 1440 m and 1098 m, respectively.

REMARKS.— *Coelorinchus spinifer* is among the deepest-living members of the genus; only a

handful of *Coelorinchus* species occur at depths greater than 1000 m. The Taiwan specimen is only the second known of the species (Iwamoto et al. 2009). The notably long and strong spinules on the scales, especially on the head ridges, in the holotype and Taiwan specimen, may reflect a juvenile condition. Until a larger size series is obtained, we are uncertain of its status within the genus. It is otherwise similar in most characters to *C. smithi*.

Genus *Coryphaenoides* Gunnerus, 1874

DISTINGUISHING FEATURES.— BR 6. Spinous second ray of 1D serrated along leading edge. Anus usually immediately before anal fin. No light organ.

REMARKS.— *Coryphaenoides* is the second largest genus of Macrouridae, with more than 60 species currently recognized, only four of which are so far known from Taiwan. Six or seven subgenera continue to be recognized, some as full genera, but the circumscription of each of these has not been based on adequate phylogenetic analyses, although some attempts have been made using very limited numbers of species (e.g., Wilson et al. 1991; Wilson 1994), Wilson and Attia (2003) using DNA sequencing, peptide mapping of lactate dehydrogenase, and protein electrophoresis; and Rao-Varón and Ortí (2009) using nuclear and mitochondrial DNA sequences. Most of the species appear to have their primary depth range in mid-continental-slope depths, but many occur at lower-slope depths; a few are primarily found on the continental rise at depths of 2000–4000 m, and the deepest-living grenadier, *C. yaquinae* Iwamoto and Stein, 1974, has been captured in abyssal depths below 6000 m. That species and *C. armatus* (Hector, 1874) can be expected in Taiwan waters deeper than about 4000 m, and other *Coryphaenoides* species are likely to be found when depths greater than 2000 m are more thoroughly sampled. As might be expected from fishes of great depths, many of the species are known from widely separated areas throughout the world oceans. A few of the larger members of this genus are of some commercial importance. The Round-nose grenadier (*C. rupestris*) of the North Atlantic has long been targeted by commercial fishermen and some stocks have become severely depleted. The Pacific grenadier (*Coryphaenoides acrolepis*) is the target of a very limited fishery off northern California.

Key to the Species of *Coryphaenoides* in Taiwan

- 1a. V rays 7 or 8; a greatly elongated spinous 1D ray, usually more than 1.5 times HL *C. microps*
- 1b. V rays 9–12; spinous 1D ray much less than 1.5 times HL 2
- 2a. Mouth large, upper jaw extends to below posterior margin of orbit or beyond; barbel 10–23% of HL *C. rudis*
- 2b. Mouth moderate to small, upper jaw not extending beyond posterior 1/3 of orbit; barbel 6–14% of HL 3
- 3a. Interorbital space much smaller than orbit (about 1.3 into); GR-I (inner series) 9–10 total; snout acutely pointed; preopercle ridge forming acute, lobelike angle posteroventrally. *C. nasutus*
- 3b. Interorbital space much larger than orbit (about 0.7 into); GR-I (inner series) about 7 total; snout rather bluntly pointed; preopercle ridge forming shallow rounded lobe posteroventrally *C. cf. asper*

Coryphaenoides cf. asper [sensu Günther, 1877]

Coryphaenoides asper Günther, 1877:440 (holotype, BMNH 1887.12.7.88; se. of Cape Nojima [se. of Boso Peninsula], Japan, 34°37'N, 140°32'E, 1875 fm [3429 m]). Shao et al., 2008: table 2 (1 spec., Taiwan [SCS], 1982 m; first record from Taiwan).— Iwamoto et al., 2009:45–47, fig. 3 (descr.; Taiwan [SCS] spec.).

MATERIAL EXAMINED (1 spec.).— **SCS:** ASIZP 66107 (1, 92.9 HL, 435+ TL), CD 325, 1982 m.

DISTINGUISHING FEATURES (figures in square brackets are from original description).— 1D II [9] 11, P i19–i21 [25], V 10 [11], GR-I (inner) 2+5; GR-II outer 1+6/1+8; scales below 1D origin 7.5 [6], below midbase 1D 5, below 2D origin 5.5, over distance equal to pre-1D 37. Snout 29% HL, broadly pointed in lateral view, preoral length short, 16%, orbit small, 19%, about 1.5 into snout length, interorbital width 28%, orbit to preopercle 48%, upper jaw 33%, barbel 14% (about 1.3 times in orbit diameter), greatest body depth 81%, 1D-2D interspace 21%, height 1D 91%, length 1D base 26%, length V 83%. Second spine of 1D serrated, produced beyond segmented rays, outer V ray prolonged. Upper jaw extends posteriorly to below middle of orbit. Head fully scaled except over gular and branchiostegal membranes; modified, thickened scales above suborbital ridge; body scales covered with slender spinules in about 5 divergent rows.

DISTRIBUTION.— Known only from two specimens, the holotype taken off Japan in 3429 m and the Taiwan specimen taken in the South China Sea in 1982 m.

REMARKS.— The ASIZP specimen was first recorded by Shao et al. (2008) and subsequently described in more detail by Iwamoto et al. (2009). If correctly identified, it represents only the second known specimen of the species. The absence of previous captures since the *H.M.S. Challenger* made its historic voyage in 1873–1876 is probably owed to the paucity of trawl hauls made at depths exceeding 2000 m in the area. A few character differences that we found between this Taiwan specimen and the holotype have led to some uncertainty as to its identity; it is for this reason that we consider the identification as tentative.

***Coryphaenoides microps* (Smith and Radcliffe, 1912)**

Macrourus microps Smith and Radcliffe in Radcliffe, 1912:116–117, pl. 25, fig. 3 (holotype USNM 72934, 42.5 cm long; Philippines, Lagonoy Gulf, se. Luzon, 13°37'30"N, 123°41'09"E; Albatross sta. 5511, 560 fm [1024 m]; 4 paratypes, sta. 5325 off n. Luzon, [CAS-SU 2544])

Coryphaenoides microps: Gilbert and Hubbs, 1920:418–419 (descr.; holotype and 4 paratypes, CAS-SU 2246, n. Luzon, Albatross sta. 5325, 224 fm [410 m]).— Shcherbachev and Iwamoto, 1995:300–301.— Chiou et al., 2004a: table 1 (listed from Taiwan).— Shao et al., 2008: table 2 (1 spec., SWT, 687 m).— Kim et al., 2009:108–110, fig. 3 (descr.; type spec., plus others from Philippines, Taiwan [NET], and Korea [East Sea, 115 m; first record])

MATERIAL EXAMINED (53 spec.).— **NET:** ASIZP 58265 (1, 250+ TL, 50.8 HL), Da-xi; ASZIP 60252 (1, 137 TL), Da-xi; ASZIP 61128 (4, 267+–330 TL), Da-xi; ASIZP 63838 (2, 306–413 TL), CP 195, 570 m; ASIZP 65566 (1, 93+ TL), CP 124, 1129–1165 m; ASZIP 65657 (1, 233 TL), Da-xi; ASIZP 66900 (1, 140 TL), CP 247, 480 m. **SWT:** ASIZP 63767 (1, 232+ TL), CD 194, 507 m; ASIZP 63792 (1, 365+ TL) and ASIZP 64144 (1, 268+ TL), CD 193, 821 m; ASIZP 65516 (2, 160–190 TL) and CAS 224886 (1, 175 TL, ex. ASIZP 65516), CD 142, 227–235 m; ASIZP 65526 (2, 150–200 TL), CD 138, 441 m; ASIZP 65535 (4, 130–210 TL), CD 137, 316–477 m; ASIZP 65581 (1, 295 TL), CD 229, 880–1062 m; ASIZP 65591 (8, 160–200 TL), CD 136, 998–1211 m; ASIZP 65603 (1, 359 TL), CD 133, 690–748 m; ASIZP 65617 (1, 174 TL), CD 137, 316–477 m; ASIZP 65624 (1, 395 TL), CD 229, 880–1062 m; ASIZP 65639 (1, 385+ TL), CD 229, 880–1062 m; ASIZP 66099 (1, 295 TL), OCP 301, 687 m; ASIZP 66109 (1, 320+ TL), OCP 301, 687 m; ASIZP 66111 (1, 463+ TL), OCP 301, 687 m; ASIZP 66413 (1, 220+ TL), Dong-gang; ASIZP 66425 (1, 214+ TL), Dong-gang; ASIZP 66427 (1, 166 TL), Dong-gang; ASIZP 66786 (1, 310 TL), OCP 301, 687 m; ASIZP 66799 (1, 188+ TL), OCP 302, 695 m. **No data:** ASIZP 65579 (1, 421 TL). **Other material** (Univ. Philippines, Marine Science Institute, Manila [UPMSI]): UPMSI uncat. (1, 380 TL) (no data, probably MUSORSTOM II); UPMSI uncat. (5) MUSORSTOM II sta.

79, off Luzon, 13°31.6'N, 120°33.7'E, 326–240 m; 1 Dec 1980, 210+–252 TL). **Other specimens:** USNM 72933 (holotype, 82.0 HL, 413+ TL), e. coast Luzon, Philippines, 1024 m; CAS-SU 25446 (2 paratypes, 23.7–39.9 HL, 124+–187+ TL), n. Luzon, 18°34'15"N, 121°51'15"E, 410 m.

DISTINGUISHING FEATURES.— 1D II 9–10; P i19–i21; V 7–8; GR-I (inner) 9–11 total; GR-II outer/inner 8–10/7–9; scales below midbase 1D 4.5–7.5, below 2D origin 6.0–9.5, over distance equal to snout tip-to-1D 29–35. Snout 28–33% HL, extending less than pupil diameter beyond mouth; preoral steep, short, length 11–16%; internasal narrow, width 15–21%; interorbital 18–26%; orbit 17–25%; postorbital length 47–53%; distance orbit to preopercle 40–47%; upper jaw 30–33%; barbel short, thick 8–14%; greatest body depth 61–96%; 1D-2D interspace 16–38%; second spinous ray of 1D greatly prolonged, 178–388% HL, serrations sparse, reduced or lost in large adults; length V 43–87% HL, outer ray moderately prolonged. Upper jaw extends posteriorly to below anterior 1/3 of orbit, mouth opening restricted laterally. Free margin of preopercle broadly rounded. Head scaly except narrow naked margin under snout and suborbital and all of gular and branchiostegal membranes; a tubercular scale at snout tip; body scales covered with slender reclined spinules in numerous subparallel rows. Color dark brown in adults, paler in young; fins generally pale near base, blackish distally.

DISTRIBUTION.— Off Luzon, Philippine Islands, Japan Sea off Korea, and Taiwan (SCS, NET), in 240–1024 m, but one exceptional capture at 115 m off Korea.

REMARKS.— Chiou et al. (2004b:47, table 1) listed *C. microps* from Taiwan, indirectly suggesting that the *C. marginatus* recorded by Shen et al. (1993) was an incorrect identification. Kim et al. (2009) recorded the species from the East (Japan) Sea off Korea and provided additional information on the species, comparing it with *C. marginatus*. *Coryphaenoides microps* is closely similar to *C. marginatus*, and the two species have many features in common. They can be separated by a combination of characters including orbit diameter (25–33% HL in *C. marginatus* cf. 17–25% in *C. microps*), postorbital length (42–45% HL cf. 47–56%), distance orbit to preopercle (33–40% cf. 40–47%), and length spinous 1D ray (1.5–2.5 times HL cf. 1.8–3.0). The two species belong to what Gilbert and Hubbs (1920:413) describe as “a rather well-marked group of species which agree in possessing a produced dorsal spine, a deep and sharply compressed body, and a dorsal contour horizontal behind the first dorsal fin.” Other species of this group include *C. semiscaber* Gilbert and Hubbs, 1920, *C. macrolophus* (Alcock, 1889), and *C. tydemani* Gilbert and Hubbs 1920.

Coryphaenoides nasutus Günther, 1877

Figures 10A–B.

Coryphaenoides nasutus Günther, 1877:440 (2 syntypes, BMNH 1887.12.7.78–79; 1 syntype?, MNHN 1890–0123; “south of Yedo” [Tokyo], Japan, 34°07'N, 138°00'E, *Challenger* sta. 235, 565 fm [1033 m]).— Gilbert and Hubbs, 1916:168 (45 spec., Japan: Hokkaido to e. coast Kyushu; 13 *Albatross* sta., 250–614 fm [457–1123 m]).— Okamura, 1970:140–143, pl. XXXI, text-fig. 56 (38 spec., 155–470 mm TL; Hokkaido to East China Sea, 625–1180 m).— Okamura *in* Okamura et al., 1982:165, 351, fig. 99 (8 spec., 136–234 mm TL; Kyushu-Palau Ridge).— Sawada *in* Amaoka et al. 1983:113, 195, fig. 64 (5 spec., 199–391 mm TL, 815–1100 m).— Okamura *in* Masuda et al., 1984:96, pl. 82F (compiled).— Yatou *in* Okamura and Kitajima, 1984:219, 364, fig. 155 (5 spec., 265–470 TL; Kyushu-Palau Ridge, 815–1000 m).— Iwamoto, 1990:216 (descr.).— Shao et al., 2008: table 2 (5 spec., NET, SET, 979–1268 m; first record from Taiwan).

Macrurus nasutus: Günther, 1887:132, pl. 30, fig. B (descr.; type illustrated).

MATERIAL EXAMINED (9 spec.).— **NET:** ASIZP 64113 (2, 240+–338+ TL), CP 242; ASIZP 65576 (1, 288+ TL), CP 197. **SET:** ASIZP 65511 (1, 425 TL), CP 127. **SCS:** ASIZP 65622 (1, 415



FIGURE 10. *Coyphaenoides nasutus* Gunther, 1877. A. ASIZP 64113, 338+ mm TL., fresh. B. ASIZP 65576, 288+ mm TL, preserved.

TL), CD 226. Non-types and possible types: BMNH 1887.12.7.80 [1], BMNH 1889.6.30.8–9 [2], NMI block reg. no. 114.1899 [1].

DISTINGUISHING FEATURES.— 1D II 9–11; P i18–i23; V 9–10; GR-I (inner) 1–2+7–9, GR-II outer/inner 1–2+8/1–2+7–8; scales below midbase 1D 4.5–5.5, below 2D origin 7.0–7.5, over distance equal to pre-1D len. 36–40. Snout length 27–32% HL; orbit 24–30%; interorbital width 20–24%; upper jaw 29–36%; barbel 5–8%; greatest body depth 75–97%; interdorsal [1D-2D] space variable 90–114% [2D rays rudimentary anteriorly]; length V 49–69%. Snout acutely pointed, extending short distance in front of mouth. Second spinous ray of 1D serrated, slightly produced (95–125% HL); outer V ray slightly produced. Upper jaw extends posteriorly to below middle of orbit. Head almost fully scaled except for gular and BR membranes; scales above suborbital ridge thickened and modified; a stout conical tubercle at snout tip; body scales covered with needle-like spinules in convergent rows.

DISTRIBUTION.— Pacific coast of Japan from Hokkaido to East China Sea, and Taiwan from e. coast to South China Sea. Published depth range 625–1180 m, but in Taiwan, specimens collected in 979–1268 m.

REMARKS.— Shao et al. (2008) first recorded *C. nasutus* from Taiwan and the South China Sea based on the current specimens. This species is similar in many features to *C. microps* and *C. marginatus* but has a larger, broader head, more strongly pointed snout armed with a stouter terminal scute, V rays 9 or 10 (compared with 7 or 8), and an acute preopercular ridge and angular preopercular margin.

***Coryphaenoides rudis* Günther, 1878**

Figures 11A–C.

Coryphaenoides rudis Günther, 1878:24 (lectotype BMNH 1889.12.7.74; Pacific, n of Kermadec I., Challenger sta. 171, 600 fm [1097 m]. BMNH 1887.12.7.75–77 (paralectotypes: 3).— Shcherbachev and Iwamoto, 1995:301 (Indian Ocean).— Iwamoto and Williams, 1999:170 (4 spec., nw. and se. Australia, 1120–1700 m).— Merrett and Iwamoto, 2000:754 (3 spec., New Caledonia region, 1315–1862 m).— Iwamoto and Graham, 2001:467 (descr., 2 spec., NSW, Australia, 1050–1150m).— Shao et al., 2008: table 2 (1 spec., SCS, 1982 m; first record from Taiwan).

Macrourus paradoxus Smith and Radcliffe in Radcliffe, 1912:115–116, pl. 25, fig. 1 (holotype, USNM 72932, 585 mm TL, e. Palawan, Philippines, 9°13'00"N, 118°51'15"E, 1105 fm [2021 m]).

Nematonurus macrocephalus Maul, 1951:17–22, figs. 3, 4c (holotype, MMF [mounted spec.], 210 HL, taken off Madeira).

MATERIAL EXAMINED (1 spec.).— **SCS:** ASIZP 66117 (1, 132.6 HL), CD 325, 1982 m. **SET:** NMMB-P uncat. (1, 1240 TL), Taitung.

DISTINGUISHING FEATURES.— 1D II,9–11, P i19, V 9–11, inner GR-I about 10, outer GR-II 8–9 total, scales below 2D 6–7. (Proportional measurements of Taiwan specimen in square bracket): snout length [27] 23–29% HL; preoral [17]10–12%; orbit [20] 16–26%; interorbital [27] 26–30%; upper jaw [38] 37–43%; barbel [20]10–23%; greatest body depth 80–100%; height 1D [76] 43–73%; length V [62] 50–111%. Snout low, bluntly rounded (in adults) to bluntly pointed (juveniles), scarcely extending beyond mouth in adults; no stout angular ridges on head; suborbital region vertical. Second 1D spine serrated (serrations reduced in largest specimens), slightly produced; outer V ray moderately produced. Upper jaw extends to below hind margin of orbit. Pre-maxillary teeth in narrow tapered band, outer series enlarged; mandibular teeth in about 3 series tapering to one. Head fully scaled except for gular and branchiostegal membranes; modified, thickened scales on suborbital and small tubercles at snout tip and at lateral angles; body scales densely covered with small conical spinules in irregularly divergent rows. (Measurement and count data partly from Shcherbachev and Iwamoto [1995], and Iwamoto and Williams [1999])

DISTRIBUTION.— Possibly worldwide in warm seas; depth range 600–3500 m, but usually 1000–2000 m. One of Taiwanese specimens collected in the South China Sea in 1982 m and another one was taken from off Taitung as depth not less than 400 m.

REMARKS.— Our specimen is the first collected in Taiwan waters (recorded by Shao et al. 2008: table 2) and one additional specimen was collected from SW Taiwan off Taitung. Its presence is not surprising in that the holotype of *C. paradoxus*, a synonym, was captured off e. Luzon Island in the Philippines.

Genus *Hymenocephalus* Giglioli, 1882

DISTINGUISHING FEATURES.— Snout high, relatively rounded, median nasal process forming a weak snout tip (no horizontal platelike process mesially); paired nasal bone in broad contact along median line, without wide gap around nostril cartilage; head much deeper than wide; body relatively compressed; head mucous canals greatly expanded; head covering membranous and often transparent; light organ long, small lens on chest anterior to pelvic-fin bases connected by a black streak to round posterior lens immediately before anus; ventral striae well developed; fine black lines on gular membrane oriented perpendicular to median line, not netlike; inner GR-I, lower limb 12–16; spinous ray of 1D completely smooth; chin barbel present or absent.

REMARKS.— A genus of about 20 species, four of which are known from Taiwan. Most species do not exceed about 20 cm TL. The highly developed luminescent organ system consisting

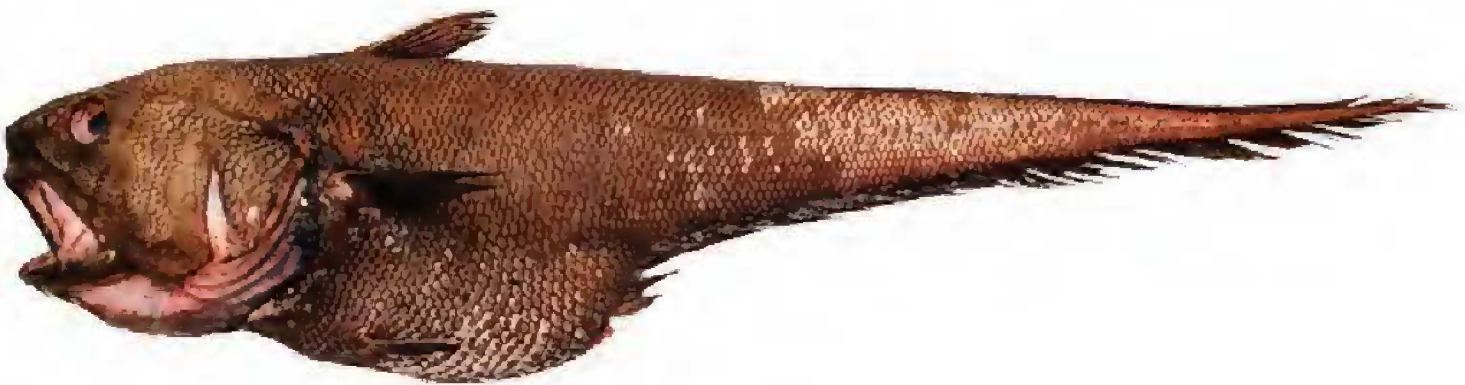
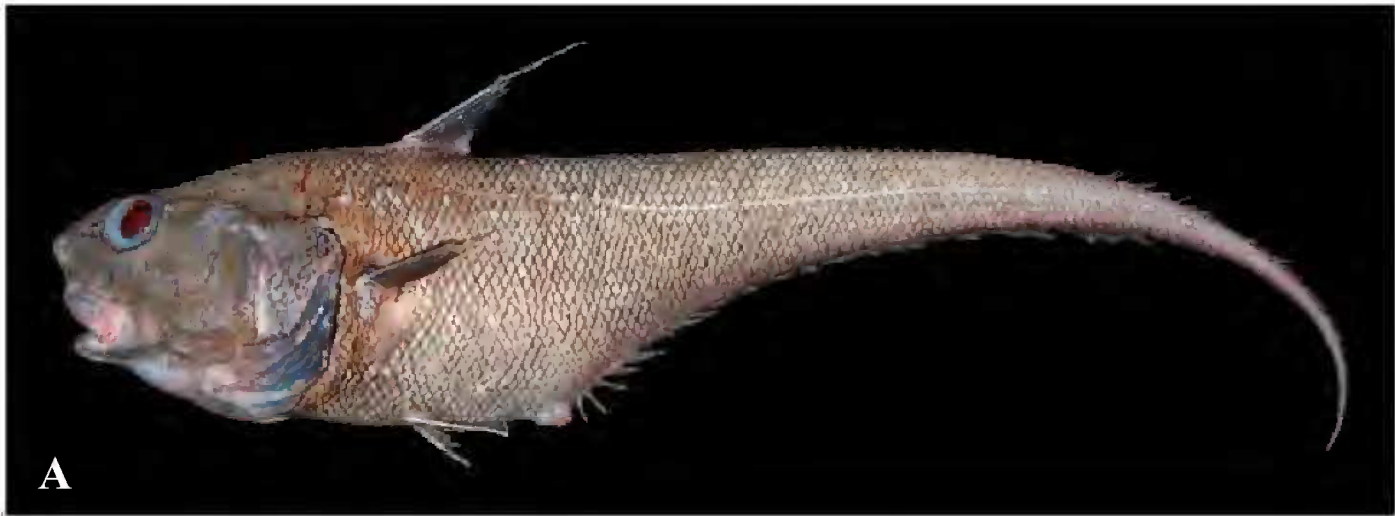


FIGURE 11. *Coryphaenoides rudis* Günther, 1878. A. ASIZP 66117, 133 mm HL, fresh. B. NMMB-P uncat., 1240 mm TL, fresh and C. same specimen, dorsal view of head.

of a network of fine striations (“ventral striae”) on the cleithrum, chest, and belly regions is seen in gadiforms only in this genus, its closely related genera *Hymenogadus* and *Spicomacrurus*, and the monotypic genera *Steindachneria* Goode and Bean in Agassiz, 1888 and *Lepidorhynchus* Richardson, 1846. The presence of two lens-like bodies of the light organ, one on the chest, the other immediately before the anus, is unique among the grenadiers to *Hymenocephalus*, *Hymenogadus*, and *Spicomacrurus*. The position of the lenses is similar to that of the ventral fossae of some species of *Coelorinchus*, but so far as we can determine, there are no comparable structures in that or other grenadiers. The delicate, paper-thin head bones and membranous head integument are usually damaged during capture, adding to the difficulties of identifying specimens.

Key to the Species of *Hymenocephalus* in Taiwan

- 1a. V 7–9 2
 1b. V 11 or 12 3
 2a. Barbel long, about 50% HL; orbit diameter 27–31% HL..... *H. longiceps*
 2b. Barbel about 11–18% HL; orbit diameter 34–45% HL *H. striatissimus striatissimus*
 3a. Barbel absent; orbit diameter 28–35% HL; color grayish brown in preservative, somewhat silvery in life..... *H. lethonemus*
 3b. Barbel rudimentary, about 4% HL; orbit diameter 23% HL; color mostly blackish
 *H. papyraceus*

Hymenocephalus lethonemus Jordan and Gilbert 1904

Hymenocephalus lethonemus Jordan and Gilbert, 1904:615, text-fig. (holotype, USNM 50936; Sagami Bay, Japan, 120–265 fm [219–485 m]; paratypes, CAS-SU 8641 [3 spec.], USNM 51455 [3 spec.]).— Gilbert and Hubbs, 1916:188–189 (22 spec., s. Japan, East China Sea, 197–440 fm [360–805 m]).— Okamura, 1970:54–56, pl. II, text-fig. 23 (83 spec., 85–140 mm TL; e. coast of s. Japan).— Yatou in Okamura et al., 1982:143, 347, fig. 87 (p. 142) (7 spec., 175.5–233 mm TL; Kyushu-Palau Ridge).— Okamura in Masuda et al., 1984:94, pl. 80–G (compiled).— Okamura in Okamura and Kitajima, 1984:201, 358, fig. 142 (p. 200) (8 spec., 148–180 mm TL; East China Sea [Okinawa Trough]; 570–810 m).— Chiou et al., 2004b:44, fig. 12 (13 spec., ne. Taiwan).— Shao et al., 2008: table 2 (21 spec., Taiwan [NET, SWT, SCS], 441–1040 m).

MATERIAL EXAMINED (36 spec.).— **NET:** ASIZP 61231 (1, 126 TL), Da-xi; ASZIP 64270 (2, 105+–108+ TL), CP 234, 547 m; ASZIP 66974 (12, 112–124 TL), Da-xi. **SWT:** ASIZP 65561 (1, 120+ TL) and ASIZP 65611 (1, 115 TL), CD 203, 634–866 m; ASIZP 65598 (3, 120–155 TL), CD 138, 441 m; ASIZP 65604 (1, 133 TL) and ASIZP 66946 (1, 330 TL), CD 134, 736–1040 m; ASIZP 66731 (1, 97 TL), OCP 317, 515 m; ASIZP 66871 (5, 43–68 TL), OCP 312, 517 m; ASIZP 66872 (1, 78 TL), CD 311, 516 m; ASIZP 66873 (4, 50–80+ TL), OCP 313, 516 m; ASIZP 67582 (2, 75+–95+ TL), CP 348, 395 m. **Other specimens:** ASIZP 67976 (1, 151 TL), Aurora.

DISTINGUISHING FEATURES.— ID II 9–11; P i13–i16; V 11 (rarely 12); inner GR-I 21–25 total; pyl. caeca 11–16. Head about 5–6 in TL; body depth about 8.0–9.5 TL. Snout high, pointed; mouth large, upper jaw extending posteriorly to below hind margin of orbit; barbel absent; gill openings wide, gill membrane free over isthmus; outer gill slit about as wide as orbit. Attains about 180 mm TL. (Compiled from Okamura [1970] and Gilbert and Hubbs [1916]).

DISTRIBUTION.— Pacific coast of s. Japan, East China Sea off Kyushu Is., Japan, and Taiwan (NET, SWT, SCS), in 360–1040 m.

REMARKS.— Okamura (1970:56) noted that among members of *Hymenocephalus*, this is the deepest-occurring in Japan.

Hymenocephalus longiceps Smith and Radcliffe, 1912

Hymenocephalus longiceps Smith and Radcliffe in Radcliffe, 1912:111–112, pl. 23, fig. 3 (holotype, USNM 72928; off se. Luzon, Philippines, 201 fm [368 m]; paratypes, USNM 149297).— Yatou in Okamura et al., 1982:141, 346, fig. 85 (p. 140) (5 spec., 135–225.5 TL; Kyushu-Palau Ridge, 420–555 m).— Okamura in Masuda et al., 1984:93, pl. 80–D (compiled).— Okamura in Okamura and Kitajima, 1984:199, 357, fig. 140 (p. 198) (5 spec., 184–230 mm TL; East China Sea [Okinawa Trough], 353–490 m).— Shen et al., 1993:171 (descr.).— Chiou et al., 2004b:37, 47 (in key, list).— Shao et al., 2008: table 2 (41 spec., Taiwan [NET, SWT, SCS], 227–1211 m).

Hymenocephalus (Hymenocephalus) longiceps: Gilbert and Hubbs, 1920:525–526 (63 spec., South China Sea off Hong Kong and Taiwan, Philippines, “East Indies,” 107–298 fm [196–545 m]).— Okamura, 1970: 45–47, pl. XIV (9 spec., 156–240 m TL; Pacific coast s. Japan, 300–500 m).

MATERIAL EXAMINED (47 spec.).— **NET:** ASIZP 61235 (1, 195 TL), Da-xi; ASIZP 61236 (6, 96–152 TL), Da-xi; ASIZP 66373 (1, 160 TL), Nan-fang-ao. **SCS:** ASIZP 65546 (1, 160+ TL), CD 137, 316–477 m; ASIZP 65554 (1, 200 TL) and ASIZP 65563 (1, 160 TL), CD 142, 227–335 m; ASIZP 65589 (5, 125–155 TL) and ASIZP 65606 (4, 125+–170 TL), CD 136, 998–1211 m. **SWT:** ASIZP 60321 (1, 128 TL), Dong-gang; ASZIP 62270 (2, 100+–130+ TL), Dong-gang. **SCS:** ASIZP 66269 (1, 170+ TL), ASIZP 66797 (13, 87+–118+ TL), and ASIZP 66879 (2, 63+–101+ TL), CD 311, 516 m; ASIZP 66739 (1, 100+ TL), CP 315, 509 m; ASIZP 66836 (1, 26.1 HL, 110+ TL) and ASIZP 66867 (1, 88 + TL), CP 314, 509 m; ASIZP 66837 (1, 168+–177+ TL), CD 311, 516 m. **Other specimens:** ASIZP 67841 (1, 200 TL), Aurora, 358–342 m; ASIZP 67949 (1, 90 TL), Aurora, 269–277 m; ASIZP 68031 (1, 120 TL), Aurora, 500–524 m; ASIZP 68192 (1, 166 TL), Auroa, 442–431.

DISTINGUISHING FEATURES.— 1D II 9–10; P i13–i17; V 8; inner GR-I 18–23 total; pyl. caeca 18–22. Orbit 27–31% HL; upper jaw 53–59%. Head rather low, its length about 5–6.5 in TL; body depth about 7–8 in TL. Snout low, broadly rounded, not projecting beyond mouth; barbel long, more than orbit, about 2 in HL. Attains about 240 mm TL. (Compiled from Okamura, 1970 and Gilbert and Hubbs, 1916).

DISTRIBUTION.— Known from s. Japan to South China Sea, Philippines, Sulu Sea, Bohol Sea, and Celebes Sea, in 196–555 m. The species was taken in 227–1211 m depth off Taiwan.

REMARKS.— The long barbel and low, rounded snout distinguish this species from all others of the subgenus from Taiwan. It is closely similar to *H. longibarbis* Günther, 1887 and the two may be synonymous.

Hymenocephalus papyraceus Jordan and Gilbert, 1904

Figure 12.

Hymenocephalus papyraceus Jordan and Gilbert, 1904:614. fig. (holotype USNM 50935, 147 mm TL; Sagami Bay, Japan, 120–265 fm [219–485 m], *Albatross* sta. 3697).— Okamura, 1970:56–58, pl. XVII, text-fig. 24 (1 spec., 95 mm TL, Pacific coast s. Japan).— Sazonov, 1993:117–121 (fig.) (1 spec., East China Sea; 800–826 m).

Hymenocephalus (Papyrocephalus) papyraceus: Gilbert and Hubbs, 1920:539 (included as one of three species in new subgenus).

Hymenocephalus papiraceus: Okamura in Masuda et al., 1984:94, pl. 344–I (species name misspelled; compiled).

MATERIAL EXAMINED.— **NET:** NMMB-P9121 (1, 25.7 HL), Da-xi.

DISTINGUISHING FEATURES.— 1D II,10; P i14; V 11; GR-I (outer/inner) 0+16/5+17, GR-II 5+17/4+16. Orbit 23% HL, 1.4 into postorbital; interorbital 35%; internasal width 23%; suborbital 19%; postorbital 54%; orbit to preopercle angle 54%; upper jaw 47%; barbel 3.5%; 1D-2D interspace 60%; P length 70%; V length 62%; length outer V to A origin 54%; pre-anal length 144%; length outer gill slit 27%. Head relatively deep and broad; orbit not included in dorsal profile; nape high, beginning slightly behind posterior edge of orbit. Snout with high median nasal ridge, flexible, pointed tip projecting slightly beyond mouth. Posterior end of preopercle ridge narrowly chisel-shaped (or flathead shovel-shaped). Barbel small but distinct. Head color mostly black, but dorsal head bones and snout transparent. Entire trunk to over A origin deeply and heavily peppered; remainder of body covered with large melanophores. Ground color medium brown; A base black anteriorly. Gular and BR membranes black. Attains about 150 mm TL

REMARKS.— *Hymenocephalus papyraceus* is apparently a rare species, having been recorded only three times previously: the holotype (and only type specimen), a small specimen in poor condition reported by Okamura (1970), and the East China Sea specimen of Sazonov (1993). The Taiwan specimen is the first record from outside Japanese waters.



FIGURE 12. *Hymenocephalus papyraceus* Jordan and Gilbert, 1904. NMMB-P9121, 25.7 mm HL, preserved, photo reserved.

***Hymenocephalus striatissimus striatissimus* Jordan and Gilbert, 1904**

Hymenocephalus striatissimus Jordan and Gilbert, 1904:612–613, text-fig. p. 613 (holotype, USNM 50934. Suruga Bay, Japan, 167 fm [305 m]; paratype, CAS-SU 8549 [1]).— Gilbert and Hubbs, 1916:187–188 (22 spec., Pacific coast s. Japan and East China Sea; 360–543 m).— Yatou in Okamura et al., 1982:143, 346, fig. 86 (p. 142) (7 spec., 101–194.5 mm TL; East China Sea [Okinawa Trough], 300–555 m).— Okamura in Masuda et al., 1984:93, pl. 80–E (compiled).— Okamura in Okamura and Kitajima, 1984:199, 358, fig. 141 (p. 198) (25 spec., 148–180 mm TL; Kyushu-Palau Ridge, 425–570 m).— Shen et al., 1993:171 (descr.).— Chiou et al., 2004b:37, 47 (in key, list).

Hymenocephalus striatissimus striatissimus: Gilbert and Hubbs, 1920:529–530 (32 spec., South China Sea off Hong Kong, Taiwan, and Luzon, Philippines; 380–494 m; 3 subspecies recognized, including one new [*H. s. aeger*]).— Okamura, 1970:48–50, pl. XV (90 spec., 115–200 mm TL; Pacific coast s. Japan and East China Sea off Kagoshima Prefecture; 300–540 m; new subspecies described [*H. s. hachijoensis*]).— Shao et al., 2008: table 2 (34 spec., Taiwan [NET, ET, SCS], 100–1188 m).

MATERIAL EXAMINED (42 spec.).— **NET**: ASIZP 57973 (1, 206 TL), Nan-fang-ao; ASIZP 61233 (1, 184 TL), Nan-fang-ao; ASIZP 61234 (13, 112–162 TL), Da-xi; ASIZP 64247 (1, 110+ TL), CP 234, 547 m; ASIZP 65564 (1, 125 TL), CP 124, 1129–1165 m; ASIZP 65635 (1, 207 TL), CD 209, 508–522 m; ASIZP 70731 (1, 115 TL), Da-xi. **ET**: ASIZP 65524 (8, 145–200 TL), ASIZP 65528 (2, 160–170 TL), ASIZP 65536 (1, 161 TL), ASIZP 65600 (1, 162+ TL), and ASIZP 65619 (1, 172 TL), CD 210, 445–1185 m; ASIZP 65553 (1, 93+ TL), CD 199, 1134–1188 m. **SCS**: ASIZP 65677 (1, 140 TL), CD 311, 516 m; ASIZP 66834 (1, 117 TL), CP 314, 506 m. **Other locality**: ASIZP 67873 (1, 142 TL), Aurora, 506–542 m; ASIZP 67972 (1, 90 TL), Aurora, 507–540 m; ASIZP 68189 (1, 117 TL), Aurora, 431–442 m; ASIZP 68414 (4, 70–110 TL), Aurora, 507–540 m.

DISTINGUISHING FEATURES.— 1D II 8–10; P i11–i16; V 8 (rarely 7 or 9); inner GR-I 16–22 total; pyl. caeca 10–17. Orbit circular, large 34–45% HL, 0.9–1.0 into postorbital; upper jaw 48–59%. Head deep, length about 6–7 in TL; body depth about 8–9 in TL. Snout bluntly rounded but with short terminal point, barely projecting beyond mouth. Upper jaw extends to vertical through posterior margin of orbit. Barbel about $\frac{1}{2}$ orbit. Attains about 200 mm TL.

DISTRIBUTION.— South China Sea off Hong Kong, Taiwan, and Luzon, Philippines, and ne. Taiwan, in 445–1188 m, but mostly between about 300 and 550 m.

REMARKS.— Gilbert and Hubbs (1920) recognized three subspecies of this species: *H. striatissimus striatissimus*, *H. striatissimus aeger*, and *H. striatissimus torvus*. The last was originally described as a full species by Smith and Radcliffe (*in* Radcliffe 1912). Okamura (1970:50–54) described *H. s. hachijoensis* from two specimens taken off Hachijo, a group of remote islands about 180 nautical miles s. of Tokyo; Okamura *in* Masuda et al. (1984:93) elevated the taxon to full species. Sazonov (1994:101–102) later recorded two additional specimens from the Northwest Pacific Ridge (Emperor seamounts) and one from the Kyushu-Palau Ridge. It is distinguished from *H. s. striatissimus* by “the longer barbel, the larger head, the smaller eye, and the lower snout” (Okamura 1970:53).

Genus *Hymenogadus* Gilbert and Hubbs, 1920

DISTINGUISHING FEATURES.— Snout low, relatively pointed and protruding; paired nasal bones in broad contact along median line, without gap around nostril cartilage; head about as broad as high; body and head somewhat cylindrical; head mucous canals moderately developed; head covering mostly transparent; light organ long, small lens on chest anterior to pelvic-fin bases connected by a black streak to round posterior lens immediately before anus; ventral striae well developed; fine black lines on gular membrane oriented perpendicular to median line, not netlike; inner GR-I, lower limb 10–16; spinous ray of 1D weakly serrated; chin barbel present.

REMARKS.— Aside from the low, cylindrical body and head, pointed snout, fewer gill rakers, and the presence of serrations along the leading edge of the first dorsal fin, this genus is otherwise scarcely distinguishable from *Hymenocephalus*, in which it was originally included as a subgenus. Aside from the widely distributed *H. gracilis*, the genus contains only *H. tenuis*, which is known only from the single original record off Hawaii.

Hymenogadus gracilis Gilbert and Hubbs, 1920

Hymenocephalus (*Hymenogadus*) *gracilis* Gilbert and Hubbs, 1920:522–525, fig. 31 (holotype, USNM 78227, 96 TL, off s. Luzon, Philippines, 13 28'45"N, 121 01'12"E, 162 fm [296 m]).— Marshall and Iwamoto *in* Marshall, 1973:602–604, fig. 31 (19 spec., nw. Pacific, e. and w. Atlantic; 342–618 m).— Iwamoto and Merrett, 1997:518, fig. 20b.— Shao et al., 2008: table 2 (3 spec., Taiwan [NET, SCS], 100–950 m)

Hymenogadus gracilis: Okamura, 1970:61–63, pl. XVIII, text-fig. 27 (60 spec., 91–128 mm TL; s. Japan, 300–500 m).— Okamura *in* Masuda et al., 1984:94, pl. 80H (compiled).— Okamura *in* Okamura and Kitajima, 1984:201, 359, fig. 143 (p. 200) (3 spec., Okinawa Trough [East China Sea], 295–385 m).— Chiou et al., 2004b:44–45, fig. 13 (2 spec., ne. Taiwan).

MATERIAL EXAMINED (6 spec.).— **NET**: ASIZP 61229 (1, 118 TL), Nan-fang-ao; ASIZP 61230 (1, 120 TL), Da-xi; ASIZP 65565 (1, 60 TL), Da-xi; ASIZP 70278 (1, 105 TL), Da-xi. **Other specimens**: ASIZP 68334 (2, 96–112 TL), Aurora, 357–367 m.

DISTINGUISHING FEATURES.— 1D II9–11; P i14–i17; V 7–9, usually 8; inner GR-I 14–18 total. Body depth 50–60% HL, about 9–10 in TL; barbel long, 20–30% HL. Attains about 130 mm TL.

DISTRIBUTION.— Probably circumglobal in warm seas, but not central e. Pacific, central e. Atlantic, and central Pacific (but see Remarks), in 300–450 m.

REMARKS.— The taxonomic status of the Hawaiian species *H. tenuis* Gilbert and Hubbs, 1917 has yet to be resolved. It may be a synonym of *H. gracilis*. Okamura (1970:58) recognized *Hymenogadus* as a full genus with two included species, *H. gracilis* and *H. kuronumai*, and by implication, also *H. tenuis*. Okamura also placed *H. kuronumai* into its own subgenus *Spicomacrus* Okamura, 1970, a taxon that Iwamoto et al. (2011) elevated to full generic status. *Hymenogadus gracilis* appears to be more characteristic of oceanic elevations, such as islands,

seamounts, and ridges, than to continental landmasses, and the terete body form is suggestive of a more pelagic, active-swimming lifestyle (not benthic, as proposed by Okamura 1970:60). Surprisingly, the species was not recorded by Okamura (*in* Okamura et al. 1982) from the Kyushu-Palau Ridge. Pelagic captures have been reported (Sazonov and Iwamoto 1992) in the upper 300 m over bottom depths of >1,000 m.

Genus *Kumba* Marshall, 1973

DISTINGUISHING FEATURES.— BR 7; anus in middle $\frac{1}{3}$ of space between A and V, usually closer to the latter. Luminescent organ with one gland and lens immediately anterior to anus. Most dorsal surface of snout and almost entire ventral surfaces of snout, suborbital, and lower jaw naked. No terminal or lateral snout scute. V 8–12; GR-I (inner) 10–14 total. (After Iwamoto and Sazonov 1994.)

REMARKS.— The genus was revised by Iwamoto and Sazonov (1994) to include nine species, two of which were described as new. The species are known from few and widely scattered specimens. Three species are recorded from Taiwan, two of these were newly recorded from the area by Shao et al. (2008).

Key to the Species of *Kumba* in Taiwan

(Adapted from Iwamoto and Sazonov, 1994)

- 1a. Scaleless areas on dorsal surface of snout extending posteriorly beyond lateral nasal angles; V 9–10; orbit 37–43% HL *K. punctulata*
- 1b. Scaleless areas on dorsal surface of snout extending posteriorly only to lateral nasal angles; V 10–13; orbit 26–43% HL 2
- 2a. No pigment spots along A; barbel short, about 7% HL; orbit 26–27% HL, equal or less than interorbital width; V 10–11 *K. gymnorhynchus*
- 2b. Three black pigment spots above mid-length of A; barbel 21–33% HL; orbit 36–43% HL, much greater than interorbital width; V 11–13 *K. japonica*

Kumba gymnorhynchus Iwamoto and Sazonov, 1994

Kumba gymnorhynchus Iwamoto and Sazonov, 1994:229, figs. 3–4 (holotype, CAS 77313 [ex ZMMU P.17765]; Indian Ocean, West Australian Ridge (Broken Ridge), 30°46'S, 93°20'E, 1260–1370 m; 1 paratype, ZMMU P.17766).— Shao et al., 2008: table 2 (1 spec., Taiwan [SCS], 736–1040 m; first record from Taiwan and SCS).— Iwamoto et al., 2009:48–49, fig. 5 (data and photograph of Taiwan spec., ASIZP 65527).

MATERIAL EXAMINED.— SCS: ASIZP 65527 (1, 316 TL), CD 134, 1260–1370 m.

DISTINGUISHING FEATURES [ASIZP 65527 in square brackets; ranges from types and NMV 23944].— 1D II [10]11; P [i18] i20–i24; V [8] 10–11; inner GR-I [10] 12–13 total, inner GR-II [10] 12–13 total. Snout [27] 27–29% HL; orbit about [26] 25–26%; interorbital [24] 24–31%; suborbital [16] 16–17%; postorbital [40] 48–52%; orbit to preopercle [50] 48–50%; upper jaw [41] 39–43%; barbel [12] about 7–11%; length isthmus to anal-fin origin [44] 58–65%. Head relatively deep and compressed; snout blunt, scarcely protruding beyond wide mouth; upper jaw extends to below posterior $\frac{1}{3}$ of orbit; suborbital region flat, without sharp ridge. Spinules on scales short, conical, aligned in 1–3 comblike rows; dorsal snout surface naked to lateral nasal angles but not posteriorly. Spinous second ray of 1D finely serrated. Attains at least 400 mm TL.

DISTRIBUTION.— Originally described from two specimens taken on the West Australian (Broken) Ridge in the e. Indian Ocean in 1260–1370 m. Our specimen was collected from the South China Sea off Taiwan in 736–1040 m.

REMARKS.— The Taiwan specimen, as reported by Shao et al. (2008), represents the first record of the species from the w. Pacific and only the fourth known specimen. The two type specimens were taken off the West Australian [Broken] Ridge; a third specimen (NMV 23944) was taken off Albany in Western Australia. The species should be expected in intervening areas of the Pacific and Indian oceans. In the Taiwan specimen the counts of the pelvic and pectoral fin rays, and the inner gill rakers on first and second gill arches, and the distance between the isthmus and anal-fin origin were low and must be confirmed when other specimens are captured from the area.

***Kumba japonica* (Matsubara, 1943)**

Lionurus japonicus Matsubara, 1943:149, fig. 9 (holotype, FAKU 1951; Kumano-Nada, Japan [not seen in 2007]; 1 paratype, FAKU 1938 [not seen in 2007]).

Nezumia japonicus: Okamura, 1970:88–91, pl. XIX, text-fig. 39 (5 spec., 135–157 mm TL; s. Japan).

Ventrifossa japonica: Okamura in Okamura et al., 1982:147, 349 (10 spec.; s. Japan and Kyushu-Palau Ridge, 550–710 m).— Okamura in Masuda et al., 1984:94, pl. 81–F (compiled).— Nakabo, 2002:421 (compiled).

Kumba japonica: Iwamoto and Sazonov, 1994:231.— Chiou et al., 2004b:45, fig. 14 (2 spec.; sw. Taiwan).— Shao et al., 2008: table 2 (3 spec.; Taiwan [NET, SWT], 100–600 m).

MATERIAL EXAMINED (10 spec.).— **NET**: ASIZP 66371 (1, 93 TL), Nan-fang-ao; ASZIP 66941 (1, 140 TL), CD 210, 445+1185 m; ASIZP 70681 (1, 163 TL), Da-xi. **SWT**: ASIZP 61240 (1, 162 TL), Dong-gang; ASIZP 61241 (1, 156 TL), Dong-gang. **Other materials: Japan**: NSMT-P 58943 (1, 15.8 HL, 115 TL), 65441 (1, 17.4 HL, 113 TL), 65731 (1, 15.2 HL, 110 TL), 65733 (1, 16.0 HL, 99+ TL), 91535 (1, 16.4 HL, 111 TL).

DISTINGUISHING FEATURES.— 1D II 8–11; P i16–i22; V 9–12; inner GR-I 12–14 total; pyl. caeca 40–52. Snout 21–30% HL; preoral 16–22%; internasal width 17–21%; orbit 36–43%; interorbital 22–28%; upper jaw 37–40%; barbel 18–27%; outer gill slit 17–24%; pre-A 142–155%; isthmus to A 78–96%; body depth 63–89%; height 1D 83–88%; 1D-2D interspace 63–86%; length outer V ray 89–171%. Snout bluntly pointed, relatively high, much shorter than orbit diameter; suborbital ridge prominent; upper jaw extends to below posterior $\frac{1}{2}$ to $\frac{1}{4}$ of orbit; barbel about two-thirds of orbit. Underside of head entirely naked; naked areas dorsally on snout extend only to transverse line crossing lateral snout angles; pores on mandible large and prominent. V origin under posterior margin of operculum; P origin slightly in advance of 1D origin; A origin behind 1D. Anus located about midway between A origin and inner V bases; ADW rather large, at or slightly ahead of line connecting inner V bases. Spinules on scales short, conical, aligned in 5–8 parallel crest-like rows. Spinous second ray of 1D sparsely serrated. Three small black blotches above mid-length of A. Species small, probably not attaining more than 170 mm TL.

DISTRIBUTION.— Southern Japan, Kyushu-Palau Ridge, and Taiwan, 550–710 m (Taiwan records from 100 to 600 m).

REMARKS.— The generic placement of this enigmatic species has been problematic; its previous allocation to three different genera reflects this. One of the current authors (HCH) visited the FAKU collections in Maizuru in 2007 but was unable to locate the type specimens of this species. The three small black blotches (faint in some specimens) above the A fin are unique and highly characteristic of this species.

***Kumba punctulata* Iwamoto and Sazonov, 1994**

Figures 13A–B.

Kumba punctulata Iwamoto and Sazonov, 1994:233–234, figs. 6–7 (holotype, MNHN 1994–0034; off New Caledonia, 20°54'S, 168°21'02"E, 530 m; 1 paratype, ZMMU P.17762 (13.4 HL, 89+ TL; Bismark Sea off New Guinea, 5°20.9'S, 146°16'E; 0–1000 m).— Iwamoto and Merrett, 1997:526, fig. 23 (holotype listed

from New Caledonia).— Merrett and Iwamoto, 2000:764 (3 spec.; Vanuatu, 541–577 m).— Shao et al., 2008: table 2 (17 spec.; Taiwan [SCS], 509–516 m. first record for Taiwan).

MATERIAL EXAMINED (17 spec.).— **SCS**: ASIZP 66816 (4, 90+–131 TL), CP 315, 509 m; ASIZP 66861 (1, 95 TL) and ASIZP 66891 (3, 82+–128 TL), OCP 313, 513 m; ASIZP 66877 (2, 105+–118+ TL), CP 314, 506 m; ASIZP 66902 (3, 105–107+ TL), CP 316, 514 m; ASIZP 66942 (1, 90+ TL), CD 311, 516 m; ASIZP 66943 (3, 83+–103+ TL), OCP 317, 515 m.

DISTINGUISHING FEATURES.— 1D II 9–11; P i18–i22; V 9–10 (rarely 11); inner GR-I 12–13 total. Snout 20–29% HL; orbit 37–43%; interorbital (25)28–35%; upper jaw 40–51%; barbel 13–20%. Snout bluntly pointed, relatively high, much shorter than orbit diameter; suborbital ridge relatively flat, not sharply angular in cross section; upper jaw extends to below of middle one-third orbit; barbel about 1.4–2.2 times into snout length. Underside of head entirely naked; naked areas dorsally on snout extend only to transverse line connecting lateral snout angles. Spinules on scales short, conical, aligned in 5–8 parallel crest-like rows. Spinous second ray of 1D sparsely serrated. Origin of V under opercle, A origin under anterior half of 1D. A small species, probably not attaining more than 150 mm TL.

DISTRIBUTION.— Known from relatively few captures off Vanuatu and New Caledonia in sw. Pacific, but numerous specimens were collected in six trawls from the South China Sea off Taiwan in 509–516 m.



FIGURE 13. *Kumba punctulata* Iwamoto and Sazonov, 1994. A. ASIZP 66877, 1 of 2, 105 mm TL fresh. B. ASIZP 66816, 1 of 4, 131 mm TL, preserved.

REMARKS.— Our Taiwan specimens (as listed by Shao et al., 2008: table 2) represent the first record of the species from this region and from the nw. Pacific.

Genus *Kuronezumia* Iwamoto, 1974

DISTINGUISHING FEATURES.— BR 7. Body and head compressed and deep; snout rounded in profile, almost entirely covered with small uniform, finely spinulated scales; suborbital region vertical, without angular midlateral ridge, covered with small unmodified scales. Teeth in broad villiform bands in both jaws, outer series of upper jaw slightly enlarged. GR-I 8–11 total. Body scales small, adherent, densely covered with long slender spinules. Anus removed from A origin, closer to V bases; a dermal light organ between V bases. Color overall from gray to brown to swarthy; fins uniformly dusky to black. (After Sazonov and Iwamoto, 1994:65–65.)

REMARKS.— Seven species currently recognized, only one known from Taiwan. The genus was reviewed by Shcherbachev et al. (1992).

Kuronezumia dara (Gilbert and Hubbs, 1916)

Figure 14.

Lionurus darus Gilbert and Hubbs, 1916:197–199, pl. 10, fig. 1 (holotype, 132 mm TL, USNM 76867; Suruga Gulf, Japan, 35°06'N, 138°40'10"E, 197 fm [360 m]).

Nezumia darus: Okamura, 1970:101–102 (description from Gilbert and Hubbs, 1916).— Okamura in Okamura et al., 1982:161, 349, fig. 95 (p. 160) (2 spec., 130–144 mm TL; Tosa Bay, 355–605 m).— Okamura in Masuda et al., 1984:95, fig. 81–J (compiled).— Okamura in Okamura and Kitajima, 1984:217, 363, fig. 153 (p. 216) (2 spec., 220–318 mm TL; East China Sea [Okinawa Trough], 560–692 m).— Nakabo, 2002:424 (compiled).

Kuronezumia darus: Shao et al., 2008: table 2 (1 spec., Taiwan [SWT], 280–452 m; first record from Taiwan).

Kuronezumia dara: Shcherbachev et al., 1992:100–101 (mentioned, no additional specimens).

MATERIAL EXAMINED (1 spec.).— **SWT**: ASIZP 65514 (1, 482 TL), CD 140, 280–452 m. **Other specimens: Japan**: BSKU 27666 (1, 49.8 HL, 255+ TL), 26326 (1, 34.6 HL, 209+ TL), 44828 (1, 42.4 HL, 218+ TL), 45036 (60.0 HL, 376+ TL); HUMZ uncat. (1, 22.0 HL, 138+ TL).

DISTINGUISHING FEATURES.— 1D II, 9–10; P i21–i23; V 10–12, usually 11; GR-I (outer/inner) 0+(1–8) / 2+(8–9), GR-II 1+(7–8) / 1+(7–9); scale rows below 1D origin 12–15, below 2D origin 10.5–11.0; below mid-base 1D 8.5–10; over distance equal to pre-1D 35–42. Snout 24–30% HL; preoral length 15–19%; internasal width 18–19; orbit 25–33%; interorbital 24–25; postorbital length 44–49%; orbit to angle of preopercle 36–42%; upper jaw 30–35%; barbel 20–27%; length outer gill slit 16–20%; greatest body depth 85–97%; pre-A length 139–152%; isthmus to A 57–79%; 1D height 97–98% (3 spec.); 1D base length 28–31; 1D-2D interspace 23–41%; length outer V ray 68–87%. Head compressed, much deeper than wide; snout low, bluntly rounded, scarcely protruding beyond large mouth, lacking stout spinous tubercle at tip; upper jaw extends posteriorly about to below mid-orbit. Barbel moderately long, slender, about 0.5–0.8 of orbit. Scales small, densely covered with slender, conical spinules giving velvety feel to body surfaces; scale ridges on head not especially developed, head contours smoothly rounded. Color medium brown to swarthy, juveniles blackish overall, fins dark (usually black). A moderately large species, probably attaining about 500 mm TL; the current Taiwan specimen is the largest recorded.

DISTRIBUTION.— Pacific coast of s. Japan in 360–692 m and SCS off Taiwan in 280–452 m.

REMARKS.— Shao et al. (2008) first recorded the species from Taiwan and the South China Sea based on the ASIZP specimen. *Kuronezumia dara* is quite similar in many respects to *K. bubonis* Iwamoto, 1974, which has been recorded from the Atlantic, Pacific, and Indian oceans, includ-

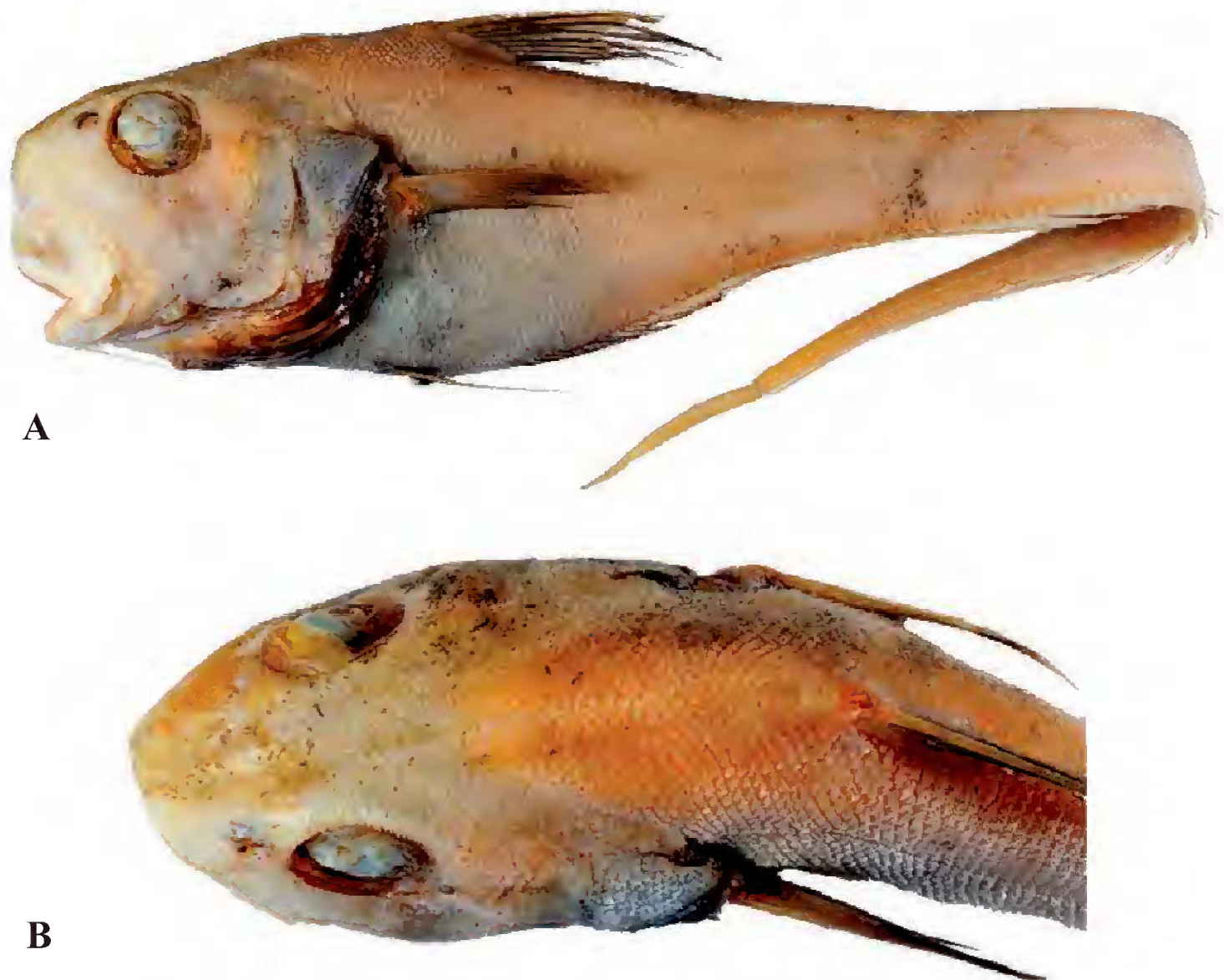


FIGURE 14. *Xuronezumia dara* (Gilbert and Hubbs, 1916). ASIZP 65514, 482 mm TL. A. lateral view. B. dorsal view.

ing the South China Sea off Vietnam (Shcherbachev et al. 1992:99–100). A notable difference is the tubercular swelling housing the light organ in *K. bubonis*, which is absent in *K. dara*.

The species-group name *darus* has been used by most Japanese authors even after the name had been transferred to the genus *Kuronezumia* by Shcherbachev et al. (1992), to which transfer those Japanese authors agree. Gilbert and Hubbs (1916) originally described the species in the masculine genus *Lionurus*, taking the Japanese term *dara* and latinizing it to *darus* to agree in gender with the genus name. When the specific name was combined with the feminine genus *Kuronezumia*, under Article 31.2 of the International Code of Zoological Nomenclature the “species-group name, if it is or ends in a Latin or latinized adjective or participle in the nominative singular, must agree in gender with the generic name with which it is at any time combined” (International Commission on Zoological Nomenclature 1999:38). Thus, the masculine species-group name *darus* must be changed to the feminine *dara*.

Genus *Lucigadus* Gilbert and Hubbs, 1920

Lucigadus Gilbert and Hubbs, 1920:553 (as subgenus of *Ventrifossa*; type species *Macrourus lucifer* Smith and Radcliffe, 1912, by original designation).— Sazonov, 1985:17 (elevated subgenus *Lucigadus* to genus level).

Lucigadella Gilbert and Hubbs, 1920:552 (as subgenus of *Ventrifossa*; type species *Macrourus nigromarginatus* Smith and Radcliffe, 1912, by original designation)

DISTINGUISHING FEATURES.— BR 7; chin barbel present; spinous ray of 1D serrated; anus

removed from A, closer to V bases; light organ well developed, two dermal windows, one before anus, the second between V bases; ventral region of body appearing to have swung far forward so that gill membranes unite below or forward of preopercle, pelvic fins below opercle; suborbital shelf covered with several rows of small relatively unmodified scales, with no sharp ridges; underside of snout mostly or completely scaled; spinules on body scales usually aligned in parallel rows; teeth in both jaws small, in tapered bands, premaxillary band not reaching beyond posterior edge of maxillary process. (Adapted from Iwamoto and Merrett 1997:526).

REMARKS.— Seven species, only one in Taiwan. Most species smaller than 20 cm TL.

***Lucigadus nigromarginatus* (Smith and Radcliffe, 1912)**

Macrourus nigromarginatus Smith and Radcliffe in Radcliffe, 1912:114, Pl. 24, fig. 2 (holotype, USNM 72930; near Simaluc I., Philippines, 5°33'15"N, 120°15'30"E, Albatross sta. 5569, 303 fm [554 m]).

Lionurus (Nezumia) nigromaculatus: Gilbert and Hubbs, 1916:145, 192 (name only, misspelled).

Ventrifossa (Lucigadella) nigromarginata: Gilbert and Hubbs, 1920:552–553 (44 spec., Philippines, Borneo, Celebes, Java Sea, in 135–392 fm [247–717 m]; new subgenus erected).

Ventrifossa nigromarginata: Shen et al., 1993:172 (descr.).— Chiou et al., 2004b:37, 47 (in key, listed from Taiwan).

Lucigadus nigromarginatus: Iwamoto and Williams, 1999:185 (mentioned).— Shao et al., 2008: table 2 (2 spec., Taiwan [NET, SWT], 100–600 m).

Lucigadus lucifer (*non* Smith and Radcliffe): Chiou et al., 2004b:46–47, fig. 15 (incorrect identification; 1 spec. from Taiwan).

MATERIAL EXAMINED (9 Taiwan spec.).— **NET**: ASIZP 57531 (1, 193 TL), Hsiao-liou-chiou; ASIZP 61308 (1, 110 TL), Nan-fang-ao. **SWT**: ASIZP (1, 158 TL), CD 142, 227–335 m; ASIZP 66322 (1, 153 TL), Dong-gang; ASIZP 67599 (1, 133 TL, 13 HL), CP 347, 305 m. **SCS**: ASIZP 65547 (2, 105–155 TL), CD 134, 736–1040 m. **Other specimens**: ASIZP 67968 (1, 149 TL), Aurora, 507–540 m. The holotype (USNM 72930) and 9 paratypes were previously examined (by TI) at the USNM. ASIZP 61630 (1, 135 TL), New Caledonia, 385–401 m.

DISTINGUISHING FEATURES.— 1D II,9–11; P i18–i21; V 10–11; inner GR-I 10–12 total, outer GR-II 9–11 total; scales below 1D 14–16, below 2D 7–9.5, lateral line scales over distance equal to pre-1D length 37–42. Snout length 24–28% HL; ventral length of snout 17–20%; orbit 33–36%; interorbital 22–26%; upper jaw 33–39%; barbel 20–26%; outer gill slit 18–21%; body depth 85–94%; height 1D 92–107%. Snout high, smoothly and bluntly rounded; nape with moderate arch; upper jaw extends posteriorly to below mid-orbit; gill openings wide, extending forward under or anterior to posterior margin of orbit; scales small, covered with small, recurved conical spinules in parallel rows, no modified thickened scales on head ridges nor tubercular scutes on snout; 1D with black blotch, anterior portion of A black, no blotches or marking on body. A small species attaining approximately 180 mm TL.

DISTRIBUTION.— Originally recorded from Philippines and Indonesia in 266–718 m; Taiwan records from 100–600 m.

REMARKS.— Taiwan appears to be the n. limit of *Lucigadus nigromarginatus*. The species is apparently not uncommon in the Philippines and the Indo-Malaysian Archipelago.

Genus *Macrosmia* Merrett, Sazonov and Shcherbachev, 1983

Macrosmia Merrett, Sazonov and Shcherbachev, 1983 (type species *Macrosmia phalacra* Merrett, Sazonov and Shcherbachev, 1983, by original designation).

DISTINGUISHING FEATURES.— BR 7; V 11–12; pyl. caeca 15–18. Chin barbel present; spinous

ray of 1D weakly serrated; anus in small periproct immediately before A; no light organ; V origin anterior to that of P; A origin below hind margin of 1D; head squamation reduced, mostly lacking on snout and underside of head, no scaled ridges on head and snout; teeth in bands in both jaws; olfactory organ massive, posterior nostril about equal to diameter of pupil, 4–5 times in HL. (Adapted from Merrett and Iwamoto 2000:767).

REMARKS.— Only the single species known. Relationships obscure, but probably most closely related to *Asthenomacrurus* or *Pseudonezumia*. Broad distribution, having been captured in the e. North Atlantic, w. South Atlantic, se. Indian Ocean, and w. Pacific Ocean.

***Macrosmia phalacra* Merrett, Sazonov and Shcherbachev, 1983**

Figures 15A–B.

Macrosmia phalacra Merrett, Sazonov and Shcherbachev, 1983:554, figs. 1–2 (holotype, ZMMU P.15390, 31.5 mm HL, 217 mm TL; Ninety East Ridge, se. Indian Ocean, 17°04.8'S, 88°09.0'E, 1650–1660 m; paratype, BMNH 1980.12.31.2, 28.5 HL, 177+ TL; Canary Passage, e. North Atlantic).— Merrett and Iwamoto, 2000:767–768, fig. 25 (1 spec., 207+ TL; Vanuatu, 1160–1220 m).— Shao et al., 2008: table 2 (8 spec., Taiwan [SCS], 1098–1293 m; first record from Taiwan).— Melo et al., 2010:35 (off Brazil).

MATERIAL EXAMINED (9 spec.).— **SCS:** ASIZP 66730 (1, 152+ TL) and ASIZP 66919 (3, 120+–145+ TL) and CAS 224493 (ex ASIZP 66919)(2, 120+–178 TL), CD 322, 1098 m; ASIZP 66775 (1, 150+ TL), CD 324, 1293 m. **Other material.** ASIZP 68275 (1, 128 TL), Aurora, 1262–1360 m.

DISTINGUISHING FEATURES.— 1D II,9; P i20–i21; V 11–12; total GR-I (outer/inner) 8/10, GR-II 11/10; scales below mid-1D 4, below 2D 6, lateral line scales over distance equal to pre-1D length about 29. Snout length 28–33% HL; preoral 20–22%; interorbital 22–25%; posterior nostril about 16%; orbit 23–29%; suborbital 13–21; orbit-preopercle 45–48%; upper jaw 30–41%; barbel 21–26%. Snout blunt, high; upper jaw extends to below mid-orbit; orbit slightly less than snout



FIGURE 15. *Macrosmia phalacra* Merrett, Sazonov and Shcherbachev, 1983. A. ASIZP 66919, 145+ mm TL, fresh. B. CAS 224493, 178 mm TL, preserved.

length; suborbital region vertical and rounded; gill openings wide, extending forward to under posterior margin of orbit; scales small, deciduous, entirely absent on underside of head and above snout; pores of cephalic lateral-line system well developed. Coloration mostly black to dark brown. Attains about 220 mm TL.

DISTRIBUTION.— Originally described from the ne. Atlantic and se. Indian Ocean, and subsequently recorded off Vanuatu in the sw. Pacific and off Brazil in the sw. Atlantic, in 1060–1699 m. Our Taiwan specimens are the first from this area and were taken at depths of 1098–1293 m.

REMARKS.— *Macrosmia phalacra* is turning out to be much more widely distributed than thought when originally described. The lack of specimens from the area between the North Atlantic and e. Indian Ocean leaves a perplexing distributional gap, but it may simply represent a collecting artifact.

Genus *Malacocephalus* Günther, 1862

Malacocephalus Günther, 1862 (type species *Macrourus laevis* Lowe, 1843 by monotypy).

DISTINGUISHING FEATURES.— BR 7; V usually 8 or 9; inner GR-I 9–14; pyl. caeca 50–100 or more. Snout smoothly rounded; sides of head relatively compressed and vertical; mouth large, usually >45% HL, upper jaws extend to or beyond vertical through posterior edge of orbits; premaxillary teeth in two rows to moderate band, with outer series enlarged; dentary teeth large, widely spaced, in one row laterally; chin barbel present; spinous ray of 1D smooth (subgenus *Malacocephalus*) or serrated (subgenus *Pawnurus*); periproct in middle third of space between V and A, usually closer to V; two dermal windows of light organ, one between V bases, the other within naked periproct region and before anus. Scales densely covered with fine needlelike spinules giving velvety feel to surface; no coarsely scaled ridges or scutes on head and snout; lowermost BR scaled. Gill membranes narrowly united over isthmus, with a free fold; gill openings extend forwards under orbits. Two short, broad retia and two wide but short gas glands.

REMARKS.— Two subgenera (*Malacocephalus* and *Pawnurus*) and seven species known, but two or three species of subgenus *Malacocephalus* may be synonyms of the widely distributed *M. laevis*.

Malacocephalus nipponensis Gilbert and Hubbs, 1916

Malacocephalus nipponensis Gilbert and Hubbs, 1916:189–191, pl. 9, fig. 2 (holotype, USNM 76866, 460 mm TL; e. coast Japan, *Albatross* st. 4967, 244–253 fm [446–463 m].— Okamura *in* Okamura et al., 1982:145, 347, fig. 88 (p. 144) (1 spec., 472 mm TL, Kyushu-Palau Ridge, 453 m).— Okamura *in* Masuda et al., 1984:94, pl. 80–J (compiled).— Okamura *in* Okamura et al., 1984:144, 360, fig. 145 (p. 202) (18 spec., 270–480 mm TL, East China Sea [Okinawa Trough], 420–550 m).— Shen et al., 1993:172 (descr.).— Chiou et al., 2004b:37, 47 (in key, list).— Shao et al., 2008: table 2 (2 spec., Taiwan [SCS], 979–1268 m, first record for Taiwan).

Malacocephalus laevis: Okamura, 1970:69–73, pl. IV, text-fig. 29–31 (56 spec., 255–520 mm TL; Pacific coast of s. Japan, 350–500 m).— Shao et al., 2008: table 2 (9 spec., NET, ET, SWT).

MATERIAL EXAMINED (20 spec.).— **NET**: ASIZP 60015 (1, 445 TL), Da-xi; ASIZP 61312 (1, 336 TL), Nan-fang-ao; ASIZP 61313 (3, 184–252 TL), Nan-fang-ao; ASIZP 65517 (1, 68 HL, 405 TL), CD 210; ASIZP 70229 (1, 287 TL), Da-xi. **SWT**: ASIZP 61314 (1, 172 TL), Dong-gang; ASIZP 62331 (2, 250+–305+ TL), Fong-gang, 200 m; ASIZP 65517 (1, 405 TL), CD 210, 445–1185 m; ASIZP 65597 (2, 360–370 TL), CD 137, 316–477 m; ASIZP 70615 (1, 196 TL), Dong-gang). **SCS**: ASIZP 58031 (2, 361–389 TL), Tong-sa Islands); ASIZP 66277 (1, 220+ TL), OCP 312, 517 m; ASIZP 66745 (1, 178+ TL), CP 314, 506 m; FRIP 0669 (1, 302 TL), FRI, 630 m; NMMSTP 0907 (1, 290+ TL), Tong-sha Islands, 515 m.

DISTINGUISHING FEATURES.— 1D II,10–14; P i16–i22; V 9 (8–10); inner GR-I 2–4+7–9; pyl. caeca 107–130. Snout 23–28%; orbit 29–37%; suborbital 11–14%; interorbital 26–31%; orbit-preopercle 42–50%; upper jaw 45–56%; barbel 18–22%. Snout bluntly pointed; mouth large, upper jaw extends to below hind margin of orbit; orbit large, greater than snout length; suborbital region vertical and smoothly curved; gill openings wide, extend forward to under posterior margin of orbit. Scales small, beset with fine, slender spinules; scales uniformly and smoothly cover head and body; no coarsely modified scales on ridges of head or tip of snout, lower branchiostegal rays scaled, but gular membrane naked. Light organ with anterior dermal window relatively small and round, situated between or slightly anterior to V bases; periproct enclosing posterior dermal window and urogenital openings located between V fins, far removed from A origin. Coloration gray to swarthy with silvery sides, blackish ventrally on head and over abdomen; fins dark dusky to black. Attains >520 mm TL. (Mostly after Okamura 1970 and from Taiwan specimens.)

DISTRIBUTION.— Pacific coast of s. Japan, East China Sea [Okinawa Trough], Kyushu-Palau Ridge, and Taiwan off ne., sw. coast and in South China Sea in 316–1185 m.

REMARKS.— *Malacocephalus nipponensis* was first synonymized into *M. laevis* Lowe, 1843 by Okamura (1970), but later (Okamura *in* Okamura and Kitajima 1982; Okamura *in* Okamura et al. 1984) considered it a valid species based on the absence of scales on the gular membrane (usually present in *M. laevis*) and the small round anterior dermal window (bean-shaped in *M. laevis*). Iwamoto (1979:149) suggested that *M. laevis*, *M. nipponensis*, and *M. hawaiiensis* Gilbert, 1905 may eventually prove to be the same. Although specimens of this species are available in many collections around the world, no one has yet to comprehensively study these collections. A molecular study may prove the easiest and the most-effective approach to resolving this question of how many species are involved in this clade. We have taken a conservative approach and treat these northwestern Pacific specimens as *M. nipponensis*, following Okamura.

Genus *Mataeocephalus* Berg, 1898

Mataeocephalus Berg, 1898:41 (replacement name for *Coelocephalus* Gilbert and Cramer, 1897, preoccupied).

Coelocephalus Gilbert and Cramer, 1897:422 (non Agassiz, 1843) (type species *Coelocephalus acipenserinus* Gilbert and Cramer, 1897, by monotypy.)

DISTINGUISHING FEATURES.— BR 6 or 7; V 7–9; inner GR-I 6–8, none or few rudiments in outer series; pyl. caeca 8–20. Snout pointed, armed with two tubercular scutes at tip, underside fully scaled to entirely naked; snout protruding well beyond small, almost inferior mouth; upper jaws about 1/2 of HL; chin barbel short; suborbital ridge sharp, angular in cross section, strongly armed with modified scutelike scales. Gill slits restricted by membranes across upper and lower arms; gill membranes broadly attached to isthmus, restricting opercular opening; gular and BR membranes naked. Dentition in both jaws in broad short bands, outer premaxillary series slightly enlarged. Spinous ray of 1D with rudimentary or well-developed serrations. Periproct moderately large, located within middle one-third of space between V and A (but closer to A in one species), rudimentary light organ developed before anus.

REMARKS.— Sazonov et al. (2003) provided a comprehensive review of the genus and described two new species. They also removed *Macrourus hyostomus* Smith and Radcliffe, 1912 from either *Coryphaenoides* or *Hyostomus* and included it as a subgenus of *Mataeocephalus*. Six species, two of which are found in Taiwan waters, although two others (*M. adustus* and *M. accipenserinus*) could be expected, based on their presence in the SCS, and for the latter, in n. Philippine Islands.

Key to Species of *Mataeocephalus* in Taiwan

- 1a. BR 6; body scales densely covered with slender somewhat flattened, reclined spinules in somewhat convergent to divergent rows *M. hyostomus*
 1b. BR 7; body scales with needle-like spinules in 12–18 parallel rows, middle row slightly enlarged *M. cristatus*

***Mataeocephalus (Mataeocephalus) cristatus* Sazonov, Shcherbachev and Iwamoto, 2003**

Figures 16A–C.

Mataeocephalus cristatus Sazonov, Shcherbachev and Iwamoto, 2003:290–291, figs. 3–4 (holotype, 48 mm HL, 215 mm TL; ZMMU P.15345, Ninety East Ridge, 11°31'S, 88°55'E, 1600–1700 m; 19 paratypes, 152–271 mm TL; w. tropical Pacific and Indian Ocean, 1000–1720 m).— Shao et al., 2008: table 2 (2 spec., Taiwan [SCS], 227–1010 m; first record from Taiwan).

MATERIAL EXAMINED (3 spec.).— **SCS**: ASIZP 66077 (1, 188 TL) and ASIZP 66912 (1, 216+ TL), CD 322, 1098 m. **SET**: ASIZP 67386 (1, 52 HL, 262 TL), CP 366, 1032 m.

DISTINGUISHING FEATURES.— BR 7; P i17–i21; V 7. Snout 35–41% HL, 1.4–2.0 times larger than orbit; orbit 21–25% HL, about equal to interorbital space; orbit to angle of preopercle 33–38% HL. Snout depressed, narrowly pointed in lateral view, broadly triangular in dorsal view, tipped with stout spiny scutes; mouth small, underslung, U-shaped; underside of head fully scaled; spinous second ray of 1D weakly serrated, slightly prolonged, its height usually 60–84% HL; body scales with needle-like spinules in 12–18 parallel rows, middle row slightly enlarged; window of light organ absent; periproct relatively small, about midway between V and A. Attains at least 271 mm TL.

DISTRIBUTION.— Broadly distributed in the w. tropical Pacific and Indian Ocean in 1000–1720 m. Our two specimens were collected from the South China Sea off Taiwan in 1032–1098 m.

REMARKS.— Shao et al. (2008: table 2) first recorded the species from Taiwan based on the current specimens. *Mataeocephalus cristatus* is quite distinct from *M. hyostomus*, its congener in Taiwan, which is classified in a separate subgenus. The two species can be distinguished by a combination of characters including BR 7 (vs. 6 in *M. hyostomus*), V ray count (7 vs. 7–8, rarely 9, in *M. hyostomus*), height of spinous 1D ray (<HL in *M. cristatus*, greatly elongated, 145–295% HL in *M. hyostomus*), snout length (35–41% HL vs. 30–36%), orbit-preopercle (33–38% HL vs. 40–44%), and length upper jaw (20–27% HL vs. 28–31%). *Mataeocephalus accipenserinus* and *M. adustus* are distinguished from *M. cristatus* by their naked underside of snout. (Mostly adapted from Sazonov et al., 2003.)

***Mataeocephalus (Hyostomus) hyostomus* (Smith and Radcliffe, 1912)**

Figures 17A–B.

Macrourus hyostomus Smith and Radcliffe in Radcliffe, 1912:121–122, pl. 27, fig. 1 (holotype, 280 mm TL, USNM 72938, Lagonoy Gulf, Luzon I., Philippines; *Albatross* sta. 5470, 560 fm [1024 m]; paratypes from Sibuku Bay, Borneo, 750 m, and Buton Strait, Celebes, 1022 m).

Coryphaenoides (Hyomacrurus) hyostomus: Gilbert and Hubbs, 1920:422–424 (redescription of types; described new subgenus *Hyomacrurus*).

Hyomacrurus hyostomus: Marshall, 1973:565 (listed).

Mataeocephalus (Hyomacrurus) hyostomus: Sazonov et al., 2003:294–296, fig. 6 (7 spec. [including holotype], 36.5–65.5 HL, 160+–283 TL; Philippines, 760–1100 m).— Shao et al., 2008: table 2 (2 spec., Taiwan [SWT, SCS], 227–1040 m; first record from Taiwan).

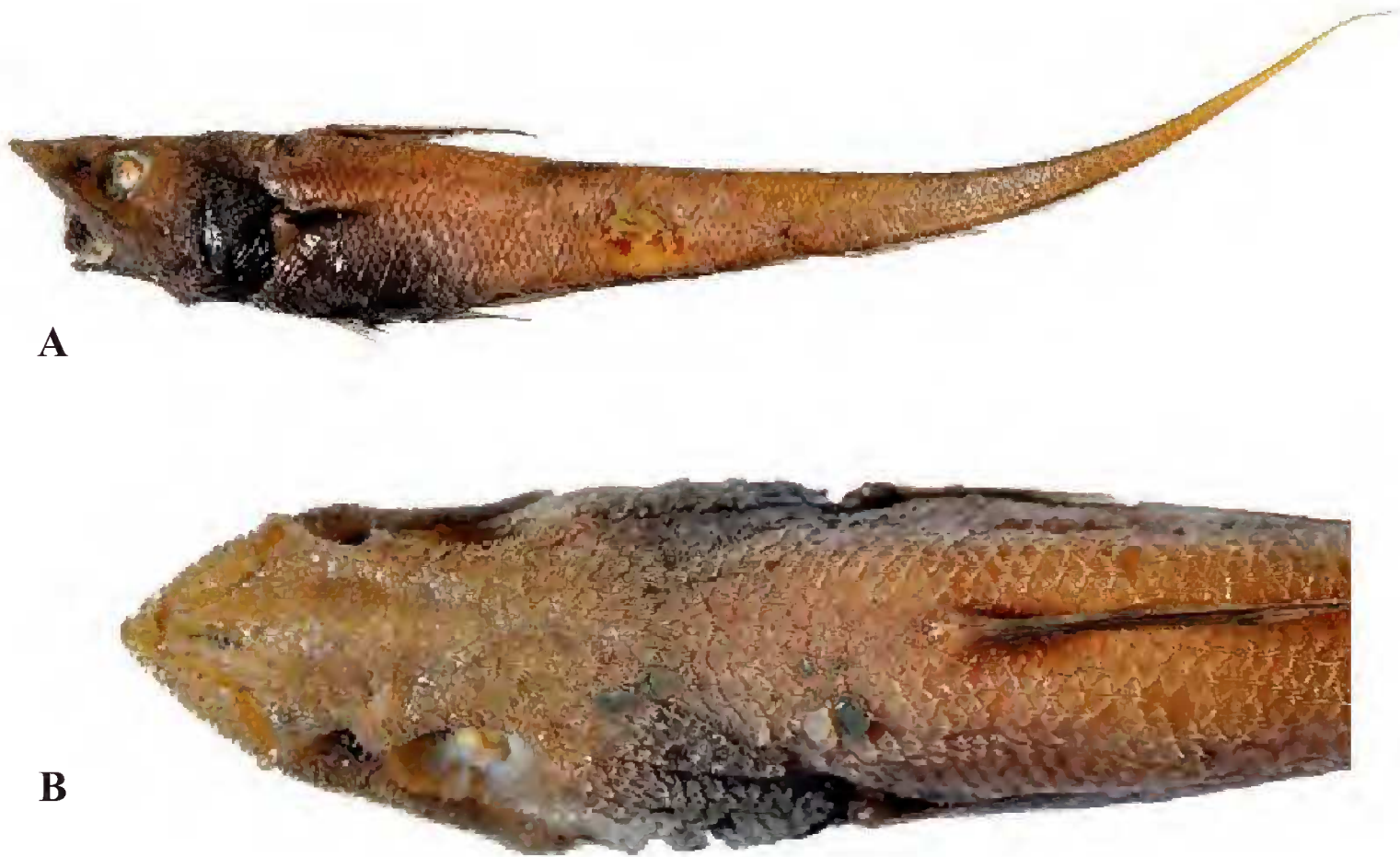


FIGURE 16. *Mataeocephalus (Mataeocephalus) cristatus* Sazonov, Shcherbachev and Iwamoto, 2003, ASIZP 66386, 262 mm TL. A. lateral view. B. dorsal view of head.



FIGURE 17. *Mataeocephalus (Hyostomus) hyostomus* (Smith and Radcliffe, 1912), ASIZP65550, 220 mm TL. A. lateral view. B. dorsal view of head.

MATERIAL EXAMINED (2 spec.).— **SCS**: ASIZP 65541 (1, 180+ TL), CD 142, 227–335 m; ASIZP 65550 (1, 220 TL), CD 134, 736–1040 m.

DISTINGUISHING FEATURES.— BR 6; P i16–i20; V 7–8; inner GR-I 5–8; scales below mid-1D 5.0–7.5; pyl. caeca 8–13. Snout 30–36% HL; orbit 22–25%; interorbital 22–26%; orbit to angle of preopercle 40–44%. Snout broad, moderately pointed and protruding; upper jaws extend posteriorly to below posterior $\frac{1}{4}$ to $\frac{1}{3}$ of orbit; spinous second ray of 1D weakly serrated near base, prolonged, 1.5 or more times HL; body scales densely covered with slender, slightly flattened, reclined spinules in somewhat convergent to divergent rows; underside of head almost fully scaled; window of light organ scarcely discernible from exterior; periproct relatively moderate in size, situated between V and A but closer to former. Attains at least 283 mm TL. (Adapted from Sazonov et al. 2003.)

DISTRIBUTION.— Known only from the Philippines, Indonesia, and Taiwan in 227–1100 m.

REMARKS.— Our two specimens collected in the South China Sea in 227–1040 m were first recorded from Taiwan and the South China Sea by Shao et al. (2008: table 2). *Mataeocephalus hyostomus* is closely similar to *M. kotlyari* Sazonov, Shcherbachev, and Iwamoto, 2003, which is found in the sw. Pacific, but *M. hyostomus* has more pyl. caeca (16–19 cf. 8–13 in *M. kotlyari*), V 7, rarely 6 vs. 7–8, rarely 9, and shorter 1D (88–119% HL vs. 124–295%).

Genus *Nezumia* Jordan, 1904

Nezumia Jordan, 1904:620 (type species *Nezumia condylura* Jordan and Gilbert, 1904, by original designation).

DISTINGUISHING FEATURES.— BR 7; V 7–17 or more; inner GR-I usually 12 or fewer; mouth subterminal, upper jaw usually <40% HL; chin barbel present; spinous ray of 1D serrated; anus removed from A, closer to V bases; periproct located between V and A, usually closer to V; light organ well developed, a small dermal window between V bases; V base usually under P base; suborbital shelf with two rows of coarsely modified scutelike scales; underside of snout scaled or naked; spinules on body scales variable, from conical to broadly triangular, in parallel to widely divergent rows; teeth in both jaws in tapered bands, outer premaxillary tooth series slightly enlarged and not extending beyond maxillary process. Ground color usually light brown to blackish to bluish; ventral and abdominal area of trunk generally dark, often underlain with blue integument.

REMARKS.— A diverse genus with approximately 48 species, but some of these may be allocated to other genera in future; others are yet to be described. There are five species represented in Taiwan waters.

Key to the Species of *Nezumia* in Taiwan

- 1a. V 8–10; 1D usually overall dusky to blackish, without prominent black blotch 2
- 1b. V 13–17; 1D with distinct black distal tip contrasting with pale proximal part of fin 4
- 2a. Underside of head mostly scaled except under snout; length second spinous 1D ray usually < HL; body scales with narrowly triangular to broadly lanceolate spinules 3
- 2b. Underside of head almost entirely naked; length second spinous 1D ray > 95% HL; body scales densely covered with needle-like spinules *N. spinosa*
- 3a. V 8 or 9, rarely 10; underside of snout naked only along median line *N. proxima*
- 3b. V 10; underside of snout virtually entirely naked *N. cf. coheni*

- 4a. V 13–15; scale rows below mid-1D 7.0–7.5, below 2D origin 8.5–10.0; length outer V ray 66–127% HL *N. evides*
 4b. V 13–17; scale rows below mid-1D 8.0–9.5, below 2D origin 10.0–13.0; length outer V ray 68–81% HL *N. condylura*

***Nezumia condylura* Jordan and Gilbert, 1904**

Nezumia condylura Jordan and Gilbert in Jordan and Starks, 1904:620–621, pl. 4, fig. 2 (holotype, 195 mm TL, USNM 50937; Suruga Bay, Japan, 207–257 fm [379–470 m]; paratypes, CAS-SU 8551).— Okamura, 1970:85–88, pl. VII, text-fig. 38 (71 spec., 153–207 mm TL; Pacific coast s. Japan, 360–720 m).— Okamura in Okamura et al., 1982:161, 350, fig. 96 (p. 160) (7 spec., 152–200 mm TL; Kyushu-Palau Ridge).— Okamura in Masuda et al., 1984:95, pl. 81–G (compiled).— Okamura in Okamura and Kitajima, 1984:215, 362, fig. 151 (5 spec., 170–204 mm TL; Okinawa Trough [East China Sea], 510–760 m).— Iwamoto, 1990:269–370, fig. 625–626 (descr. compiled).— Chiou et al., 2004b:45, fig. 16 (25 spec.; Taiwan [NET, ET, SCS], 400–1211 m).

Lionurus condylura: Gilbert and Hubbs, 1916:195–197 (29 spec., 103–204 mm TL; Pacific coast s. Japan, 197–440 m).

MATERIAL EXAMINED (33 spec.).— **NET**: ASIZP 61238 (1, 186 TL), Nan-fang-ao; ASIZP 61239 (8, 116–124 TL), Nan-fang-ao; ASIZP 64104 (1, 193 TL), CP 235, 764 m; ASIZP 65552 (1, 110 TL) and ASIZP 65607 (2, 114+–162+ TL); CD 210, 445–1185 m; ASIZP 65625 (2, 139–153 TL), CD 211, 517–529 m; ASIZP 65631 (1, 168 TL), CD 209, 508–522 m; ASIZP 65638 (1, 164 TL), CD 214, 488–1027 m; ASZIP 65643 (1, 132 TL), Da-xi; ASIZP 65663 (1, 192 TL), Da-xi; ASIZP 70683 (3, 25–28 HL), Da-xi. **SCS**: ASZIP 58022 (2, 131–133 TL), Tong-sha Islands; ASIZP 65587 (1, 155+ TL), CD 136, 998–1211 m; ASIZP 66803 (3, 27.8–33.0 HL, 160+–210+ TL); CD 320, 731 m; ASIZP 66831 (2, 20–23.6 HL, 105+–117+ TL); CP 315, 509 m; ASIZP 66894 (2, 16.8–22.8 HL, 82+–130+ TL), OCP 312, 517 m. **Other specimen**: ASIZP 68038 (1, 120+ TL; Aurora, 500–524 m).

DISTINGUISHING FEATURES.— 1D II,10–13; P i18–i22; V 13–17; inner GR-I 8–11 total; scale rows below midbase 1D 8–9.5, below 2D 10–13; pyl. caeca 25–28. Snout length 27–30% HL; interorbital 23–27%; orbit 29–36%; upper jaw 29–33%; barbel 14–21%. Body relatively deep, about equal to HL; head 6.4–6.7 in TL; snout short, high, projecting slightly beyond mouth, with stout tubercles at tip and lateral angles; mouth rather small, upper jaw extends posteriorly to under posterior margin of pupil; barbel well developed, about $\frac{2}{3}$ orbit diameter; suborbital ridge sharp, beset with two rows of thickened scales; underside of head naked except along peopercle; pores of cephalic lateralis system prominent; body scales densely covered with short, conical spinules arranged in 4–16 parallel rows. Spinous 1D ray about equal to HL, with slender, widely spaced serrations. Anterior dermal window of light organ small, situated between inner V-fin bases; anus closer to A than to outer base of V. Color yellowish gray to grayish brown, trunk, gill and gular membranes purplish-black; mouth and gill cavities dark; 1D with black tip, V and anterior portion of A black, other fins pale. Attains about 210 mm TL.

DISTRIBUTION.— Pacific coast of s. Japan, East China Sea, and South China Sea in 360–910 m, and off Taiwan in 400–1211 m.

REMARKS.— Differences between *N. condylura* and *N. evides* are slight and need to be more adequately determined. Iwamoto (1990:281) differentiated the two based on V fin-ray count, length P, and position of anus relative to V and A, but in the same volume (1990:270) said “this species may be the same as *N. propinqua*.” Okamura (1984) cited “the shorter distance between the vent and the origin of anal fin, dense outer premaxillary teeth, etc.” to distinguish *N. condylura* from *N. propinqua*.

***Nezumia evides* (Gilbert and Hubbs, 1920)**

Figure 18.

Lionurus evides Gilbert and Hubbs, 1920:557, fig. 39 (holotype, USNM 78231; near Sibuko Bay [Celebes Sea], Borneo, 4°12'10"N, 118°38'08"E, 260 fm [475 m]; 7 paratypes).

Nezumia evides: Iwamoto, 1990:262, fig. 614 (in key).— Iwamoto and Williams, 1999:201 (mentioned).— Shao et al., 2008: table 2 (5 spec., Taiwan [NET, SCS], 488–1027 m; first record from Taiwan).

MATERIAL EXAMINED (17 spec.).— **NET**: ASIZP 65641 (4, 147–175+ TL), CP 214, 488–1027 m; ASIZP 70699 (2, 156–162 TL), Da-xi. **SCS**: ASIZP 66830 (1, 127+ TL), OCP 317, 515 m. **Other specimens**: CAS-SU 25467 (4 paratypes, 19.6–27.5 HL, 104+–146+ TL), off Borneo, 475 m; CAS-SU 25468 (3 paratypes, 22.8–23.5 HL, 12–132+ TL), Molucca Sea off Halmahera [Gillolo], 545 m; and Aberdeen Fishery Station, Hong Kong uncat. (3, 22.3–27.5 HL, 120–160 TL), SCS s. of Hainan Is., 200–400 fm [366–732 m].

DISTINGUISHING FEATURES.— 1D II,9–13; P i16–i21; V 13–15; inner GR-I 8–11 total; scale rows below midbase 1D 7.0–7.5, below 2D 8.5–10; pyl. caeca about 25. Snout length 27–33% HL; interorbital 24–29%; orbit 31–36%; orbit to angle of preopercle 32–36%; upper jaw 29–34%; barbel 13–18%; length outer ray V 83–127%. Body relatively deep, 82–92% HL; head 4.1–5.8 in TL; snout short, high, projecting slightly beyond mouth, with stout tubercles at tip and lateral angles; mouth rather small, upper jaw extends posteriorly to under posterior margin of pupil; barbel well developed, about $\frac{2}{3}$ to $\frac{1}{2}$ orbit diameter; suborbital ridge with coarsely modified scales; underside of head to end of upper jaw and mandibular rami naked; body scales densely covered with short, conical spinules arranged in 8–13 parallel rows. Spinous 1D ray about equal to HL, denticulation on leading edge widely spaced; outer V ray extends to 10th to 20th A ray. Anterior dermal window of light organ small, situated between inner V bases; anus between V and A, but usually closer to inner V bases. Color in alcohol overall brownish, opercle and abdomen blackish with silvery sheen, abdomen underlain with bluish; mouth and gill cavities dark; 1D with distinct black tip. A small species, probably not much >160 mm TL.

DISTRIBUTION.— From Taiwan, South China Sea, Philippines, Celebes Sea, Molucca Sea, in 475–1027 m; the Taiwan specimens were collected in 517 m (NET) and 488–1027 m (SCS).

REMARKS.— Our specimens represent the northernmost record, and the first record (as reported by Shao et al. 2008) from Taiwan and the South China Sea. *Nezumia evides* closely resembles *N. condylura* and *N. propinqua* in having similar head shape, high V counts, naked underside of snout and mandibles, black-tipped 1D, and scale size and spinulation. The slightly lower counts of V rays, somewhat longer outer V ray, slightly fewer scales below mid-1D and below 2D origin (7–7.5 vs. 8–9.5 and 8.5–10 vs. 10–13, respectively), shorter body (HL 4.1–5.9 in TL vs. 6.4–6.7), and possibly smaller size attained distinguish *N. evides* from the two.

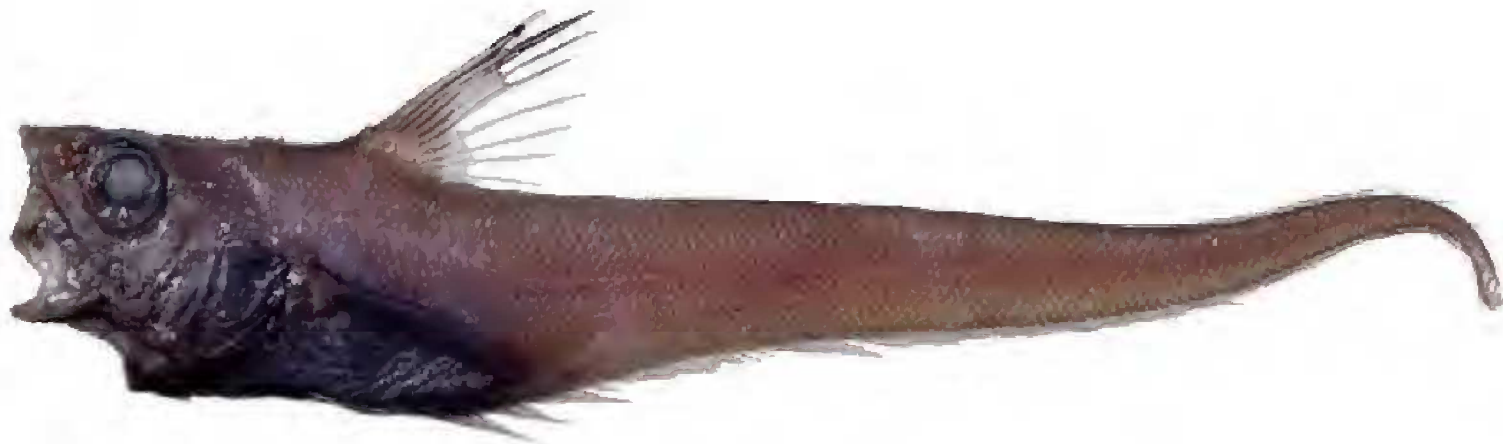


FIGURE 18. *Nezumia evides* (Gilbert and Hubbs, 1920). ASIZP 66830, 127 mm TL, fresh.

***Nezumia proxima* (Smith and Radcliffe, 1912)**

Figure 19.

Macrourus proximus Smith and Radcliffe in Radcliffe, 1912:119–120, pl. 26, fig. 2 (holotype, 292 mm TL, USNM 72936; Sogod Bay, Leyte I., Philippines, 10°12'00"N, 125°04'10"E, 502 fm [918 m]; paratypes, USNM 135338–39).

Macrourus nasutus [non *Coryphaenoides nasutus* Günther, 1877]: Jordan and Gilbert, 1904:618 (spec. from off Izu, Japan).

Lionurus proximus: Gilbert and Hubbs, 1916:201–202 (11 spec. [excluding 3 types]; East China Sea, Pacific coast of s. Japan, 361–544 fm [660–995 m]).

Lionurus (subgenus *Nezumia*) *proximus*: Gilbert and Hubbs, 1920:554 (3 spec. [including holotype], Philippines).

Lionurus abei Matsubara, 1943:146–147, fig. 7, 8 (holotype, 160.7 mm TL, cat. no. 4909, Kumano-nada, Japan; “Sigenkagaku Fish Coll. No. 7”).

Nezumia proximus: Okamura, 1970:94–98, pl. XXI, text-fig. 41(17 spec., 174–370 mm TL; e. coast s. Japan, East China Sea; 420–910 m; synonymized *Lionurus spinosus* Gilbert and Hubbs, 1916 with *N. proxima*).

Nezumia proxima: Okamura in Okamura et al., 1982:163, 351, fig. 98 (p. 162) (1 spec., 160 mm TL; Kyushu-Palau Ridge).—Sawada in Amaoka et al., 1983:107, 192, fig. 58 (p. 106) (4 spec., 269.6–346.4 mm TL; Ibaragi [central Honshu, ca. 37°N], Japan, 1100 m).—Okamura in Masuda et al., 1984:95, pl. 81–I (compiled).—Okamura in Okamura and Kitajima, 1984:217, 362, fig. 152 (p. 216) (8 spec., 186–350 mm TL; Okinawa Trough [East China Sea], 820–932 m).—Iwamoto, 1990:281–282, fig. 645–646 (compiled).—Nakabo, 2002:424 (compiled).—Shao et al., 2008: table 2 (2 spec., Taiwan [ET, SCS], 488–1098 m; first record from Taiwan).

MATERIAL EXAMINED (2 spec.).—**NET**: ASIZP 65632 (1, 377+ TL), CP 214, 488–1027 m. **SCS**: ASIZP 66187 (1, 32 HL, 163+ TL); CD 322, 1098 m. **SWT**: ASIZP 65529 (1, 282+ TL), CD 142, 227–335 m.

DISTINGUISHING FEATURES.—1D II,9–11; P i17–i21; V 9, rarely 10; inner GR-I 9–11 total; scale rows below midbase 1D 5–7.5, below 2D 7–8.5; pyl. caeca 24–31. Snout length 23–31% HL; interorbital 18–25%; orbit 28–33%; suborbital 14–17%; upper jaw 31–34%; barbel 15–23%. Body relatively slender, compressed; head in TL about 6–7 times; snout conical, protruding well beyond mouth, with stout tubercles at tip and lateral angles; suborbital ridge sharp and beset with stout modified scales; underside of head mostly scaled except for broad naked median swath on underside of snout; body scales densely covered with recumbent narrowly triangular to lanceolate spinules. Long spinous ray of 1D about 70–100% HL, serrations strong, sharp, widely spaced. Anterior dermal window of light organ small, situated between inner V-fin bases; anus about midway between V and A. Color overall dark brown, abdominal region bluish to black; gill cover, gill membranes black; mouth dusky; fins dark dusky to black. Attains at least 380 mm TL.

DISTRIBUTION.—Broadly distributed from east-central Japan and East China Sea to South China Sea off Taiwan and the Philippines; recorded depth range 355–1100 m. The sw. Taiwan specimen was taken in 227–335 m; the ne. Taiwan specimen in 488–1027 m, and the SCS specimen in 1098 m.

REMARKS.—The 133 mm specimen listed in the table in Gilbert and Hubbs (1916:202) as *N. proxima* from *Albatross* sta. 4918 is deposited at CAS [cat. no. CAS-SU 22941]; we have determined that it represents *N. spinosa*, a species that is closely similar to *N. proxima* and with which it has been mistaken in the past. However, the underside of head of *N. spinosa* is almost wholly naked, compared with only the median portion of snout in front of the mouth naked in *N. proxima*. The spinous 1D ray is also longer in *N. spinosa*, the scale spinules needle-like and not flattened (viz., not lanceolate or spear-shaped), and the outer premaxillary dentition is larger than in *N. proxima*.



FIGURE 19. *Nezumia proxima* (Smith and Radcliffe, 1912), ASIZP 66187, 163+ mm TL, fresh (A) and preserved (B).

***Nezumia spinosa* (Gilbert and Hubbs, 1916)**

Figures 20A–B.

Lionurus spinosus Gilbert and Hubbs, 1916:199–200, pl. 10, fig.2 (holotype, USNM 76868, East China Sea off Japan, 427 fm [781 m]).— Gilbert and Hubbs 1920:554 (4 spec., off Luzon, Philippines).— Okamura, 1970:94 (in part; in synonymy of *Nezumia proximus*).

Nezumia spinosa: Okamura in Masuda et al., 1984:95, pl. 345–A (compiled).— Iwamoto, 1990:254, fig. 582 (in key).— Iwamoto and Anderson, 1994:18–19 (22 spec., 26.3–44.2 HL; 117–255 mm TL, s. Africa and Mozambique, 560–1000 m).— Iwamoto and Merrett, 1997:542–545, fig. 29b (8 spec., 20–54.2 HL, 133–319 TL; sw. Pacific, Japan, South China Sea, 660–900 m).— Iwamoto and Williams, 1999:202–204, fig. 43b (8 spec., 33.3–51.1 HL, 140–260+ TL, Western Australia, 420–853 m).— Merrett and Iwamoto, 2000:772–773 (1 spec., 45 HL, 250+ TL; Norfolk Ridge [sw. Pacific], 640–740 m).— Shao et al., 2008: table 2 (3 spec., Taiwan [SWT, SCS], 316–720 m; first record from Taiwan).

MATERIAL EXAMINED (6 spec.).— **SWT**: ASIZP 65545 (1, 170 TL), CD 137, 316–477 m; ASIZP 67586 (2, 105+–160+TL), CP 338, 569 m; ASIZP 67591 (1, 34 HL, 159+ TL); CP 338, 569 m. **SCS**: ASIZP 66747 (1, 216+ TL), CD 320, 731 m; ASIZP 66817(1, 127+ TL), CP 315, 509 m.

DISTINGUISHING FEATURES.— 1D II,9–10 (rarely 8 or 12); P i18–i22; V 8–9; inner GR-I 9–12 total; scale rows below midbase 1D 6.5–9, below 2D 7.5–11; lateral line scales over distance equal to predorsal length 35–42; pyl. caeca 15–16 (13–14 fide Iwamoto and Anderson 1994:18). Snout



FIGURE 20. *Nezumia spinosa* (Gilbert and Hubbs, 1916). A. ASIZP 67586, 105 mm TL, fresh. B. ASIZP66817, 127+ mm TL, preserved.

length 28–32% HL; preoral length 18–29%; interorbital 18–24%; orbit 29–31%; orbit to preopercle 34–40%; suborbital 12–14%; upper jaw 27–33%; barbel 9–18%. Body relatively slender, compressed; head about 5–6 in TL; snout conical, protruding well beyond mouth, with stout tubercles at tip and lateral angles; suborbital ridge sharp and beset with stout modified scales; underside of head almost completely naked, with large pores; body scales densely covered with long, needle-like spinules in parallel to convergent rows. Long spinous ray of 1D 96–156% HL, serrations widely spaced. Anterior dermal window of light organ prominent, situated between V-fin bases. Color overall light brown, blackish over abdomen; gill cover, gill membranes dark; mouth and gill cavities black; 1D blackish proximally, pale to whitish distally, V black, P and A dusky. Attains about 320 mm TL.

DISTRIBUTION.— A widespread Indo-Pacific species; s. Japan through Philippines, Indonesia, s. to New Caledonia region, w. coast of Australia, and s. Africa, in 316–1000 m. Our Taiwan specimens were taken in 316–731 m.

REMARKS.— Shao et al. (2008) first recorded the species from Taiwan based on the current specimens.

***Nezumia cf. coheni* [sensu Iwamoto and Merrett, 1997]**

Figure 21A–C.

Nezumia coheni (not of Iwamoto and Merrett, 1997): Shao et al., 2008: table 2 (3 spec., SWT, 1305 m; first record from Taiwan).

MATERIAL EXAMINED (3 spec.).— SWT: ASIZP 63791 (3, 290+–333+ TL), CD 192, 1305 m.

DISTINGUISHING FEATURES.— 1D II,9–11; P i19–i21; V9–10; GR-I (inner) 2+7, total GR-II (outer /inner) 8–9 / 9–10; scale rows below 2D origin 7.0–8.5, under midbase of 1D 6.5; lateral-line scales over distance equal to predorsal length 33–35. Snout conical with smoothly rounded dorsal and ventral profiles, length 31–33% HL, interorbital flat, its width 22–24%, orbit 27–32%, suborbital almost vertical, gently rounded, depth 17–19%; upper jaw 33–35%; barbel 15–20%; outer gill slit 12–16%; pre-A length 165–186%; outer V to A origin 44–50%; body depth about



B



FIGURE 21. *Nezumia* cf. *coheni*. A. ASIZP 63791, 1 of 3, 333+ mm TL, fresh. B-C. ASIZP 63791, 1 of 3, 290+ mm TK. B. lateral view. C. lateral view of left head.

77–92%; 1D-2D interspace 38–52%; height 1D 94–98%; length 1D base 24–30%; length P 51–61%; length outer V 49–54%. Underside of snout mostly naked; underside of head becoming increasingly covered with scales ventrally and posteriorly from about vertical through nasal fossa; pores and sensory papillae of cephalic lateralis system densely arrayed on underside of head, especially under snout and mandibles, producing a roughened surface texture; scales densely covered with broadly lanceolate spinules. All fins dark, blackish; dermal window of light organ relatively small and located between inner margins of V bases. Color in alcohol overall dark brownish; abdomen, gill covers, and gill membranes blackish; mouth dark but somewhat pale along outer margins; gums pale. Attains at least 333 mm TL.

DISTRIBUTION.— Known from the South China Sea off the sw. coast of Taiwan in 1305 m.

REMARKS.— Shao et al. (2008) first recorded these specimens as *Nezumia coheni* Iwamoto and Merrett, 1997, but on closer examination, certain character disparities suggested that the Taiwan specimens may represent a different species. The pelvic fin-ray count of 9 or 10 contrasts with

the usually 11 (rarely 9 or 10) of *N. coheni*. Certain proportional measurements differed slightly: suborbital depth 17–19% HL cf. 15–16% in *N. coheni*; preanal length 165–186% cf 143–166%; and barbel length into orbit diameter 1.3–1.6 times cf. 1.6–2.0 times. The spinules on body scales also have rather broadly convex tips in the Taiwan specimens compared with the more attenuated and sharp tips of *N. coheni*. Although the three Taiwan specimens are in excellent condition, they were all collected together and are all of relatively the same size and likely do not show the range of variation in the species. The similarities in most features suggest a close relationship between *N. coheni* and these Taiwan specimens, if indeed they are different. We must await collection and study of more specimens of different sizes to confirm or reject the notion of their being different species.

Genus *Pseudocetonurus* Sazonov and Shcherbachev, 1982

Pseudocetonurus Sazonov and Shcherbachev, 1982:5–6 (type species *Pseudocetonurus septifer* Sazonov and Shcherbachev, 1982 by monotypy).

DISTINGUISHING FEATURES.— BR 7; V 9 or 10, rarely 8; inner GR-I 13–18 total; pyl. caeca 22–34. Head enlarged, notably broad and deep, preopercle and suborbital bones deep and large; orbit small in adults, proportionally larger in young, diameter 19–31% HL; interorbital width 33–44% HL. Snout high, bluntly pointed, little protruding beyond mouth; mouth large, upper jaw 41–49% HL; chin barbel small, 7–10%; gill opening wide, extending ventrally to below end of maxilla. Spinous ray of 1D smooth proximally, finely serrated distally; abdominal area short, periproct between V and A, closer to V bases. Light organ developed: a small round dermal window between V bases. Head fully scaled except for gular and gill membranes; small, awl-shaped spinules on body scales, no reticulations on anterior field; grooved lateral line scales over trunk present or absent. Teeth small, in narrow band on premaxillary, in single series in dentary. Ground color black to dark brown overall.

REMARKS.— This genus is closely similar to *Ventrifossa* and would likely be categorized in that taxon except for its very dark color, greatly expanded head, and commensurately expanded bones of the opercular series. Only the single species known.

Pseudocetonurus cf. *septifer* [sensu Sazonov and Shcherbachev, 1982]

Pseudocetonurus septifer: Chiou et al., 2004b:46, fig. 17 (1 spec., ASIZP 61237, 147 mm TL; Da-xi, Taiwan [NET]).— Shao et al., 2008: table 2 (3 spec., Taiwan [NET]).

MATERIAL EXAMINED (1 spec.).— **NET**: ASIZP 61237 (1, 147 TL), Da-xi.

DISTINGUISHING FEATURES.— 1D II,8–12, usually 9 or 10; P i16–i20; GR-I (outer/inner) 7–12/13–18, GR-II 14–18/14–17. Snout length 25–34% HL; preoral length 19–27%; postorbital 47–59%; orbit to preopercle 53–64%; suborbital 19–26%; outer gill slit 23–31; body depth 75–95; V-A 12–38%; height 1D 52–66%; length V 41–63%. Head about 5.0–5.5 in TL; greatest width about 1.5 into greatest depth; interorbital about 2.3–3.0 into HL; suborbital deep, almost vertical and lacking modified scutelike scales; Mouth large, upper jaw extends to below midorbit. Barbel almost rudimentary, <0.5 orbit. Sensory canals of head greatly expanded, but sensory pores small; free neuromasts poorly developed. Grooved lateral line present.

DISTRIBUTIONS.— So far known only from the nw. Pacific off Taiwan.

REMARKS.— Based on the presence of a grooved lateral line, this specimen is probably an undescribed species. The only other member of the genus, *P. septifer* Sazonov and Shcherbachev, 1982, known from the Saly-Gomez and Nazca ridges in the southeastern Pacific and off Hawaii, lacks a grooved lateral line. The Taiwan species was first recorded as *P. septifer* by Chiou et al. (2004b) and subsequently by Shao et al. (2008).

Genus *Pseudonezumia* Okamura, 1970

Pseudonezumia Okamura, 1970:38–39 (type-species *Pseudonezumia japonicus* Okamura, 1970 by original designation).

Paracetonus Marshall, 1973:615–616 (type-species *Macrourus parvipes* Smith and Radcliffe, 1912 by original designation).

DISTINGUISHING FEATURES.— BR 7 or 8; V 6, rarely 5 or 7, situated below posterior end of head; P 16–18; anus slightly removed from A; head much deeper than wide (*P. japonica*) to relatively broad and deep (other spp.); sensory canals expanded, well developed; head and body almost fully scaled; body scales small, exposed field with erect awl-shaped spinules in subparallel to slightly divergent rows, reticulations on scales; suborbital ridge without modified scales; snout broad, tip and lateral angles lacking tubercles; teeth in narrow bands, somewhat enlarged in outer premaxillary and inner dentary series. No apparent light organ developed.

REMARKS.— We are treating the genus *Paracetonus* Marshall, 1973 as a synonym, although this has not been adequately confirmed. Sazonov and Shcherbachev (1982:11) provided a good diagnosis and discussion of relationships of the genus (as *Paracetonus*); they listed four species as belonging to the genus, including *P. flagellicauda* (Koefoed, 1927), *P. parvipes* (Smith and Radcliffe, 1912), and *P. cetonuropsis* (Gilbert and Hubbs, 1916), and their new one *P. pusillus*, but not *P. japonica* Okamura, 1970. Of the five species, only one is known from Taiwan.

***Pseudonezumia pusilla* (Sazonov and Shcherbachev, 1982)**

Figures 22A–B.

Paracetonus pusillus Sazonov and Shcherbachev, 1982:12–14, fig. 4 (holotype, ZMMU P.15306, Indian Ocean, Ninety-East Ridge, 11°24.3'S, 88°50'E, 1500–1600 m; 17 paratypes, Indian Ocean and w. Pacific off New Guinea; 1380–2000 m)

Paracetonus cetonuropsis (non Gilbert and Hubbs, 1916): Shao et al., 2008: table 2 (3 spec., Taiwan [SCS], 1098 m).

Pseudonezumia pusilla: Iwamoto and Williams, 1999:208–209, fig. 45 (1 spec., off Western Australia, w. of NW Cape; 1460–1500 m).

MATERIAL EXAMINED (5 spec.).— **SCS:** ASIZP 66945 (3, 137–163 TL) and ASIZP66424 (1, 234 TL), CD 322, 1098 m. **Other material:** CAS 224176 (1, 28.6 HL; 175+ TL), SCS, off Vietnam, 15°38'N, 111°54'E; *MV Stranger*, NAGA Exped., sta. 60–67, GVF Reg. no. 2083, 28 Feb. 1960.

DISTINGUISHING FEATURES.— 1D II,8–9; P 17–18; V 6 or rarely 7; total GR-I (outer/inner) 10–12/10–11; GR-II 10–12/10–11; pyl. caeca 7–12. Snout length 29–32% HL; preoral length 21–22%; internasal width 23–26%; interorbital 30–33%; orbit 29–31%; posterior nostril 12–16%, 2.2–2.7 times into orbit; suborbital 14–18%; postorbital 41–46%; orbit to preop. 35–42%; upper jaw 34–40%; barbel 12–20%; outer gill-slit 12–20%; pre-A 122–138%; isth. to A 57–72%; outer V to A 35–52%; 1D-2D 22–46%; length base 1D 21–29%. Head relatively compressed, deeper than wide; snout pointed, rather broad, internasal width about ¼ HL; interorbital ½ HL, slightly greater than orbit diameter; suborbital about half orbit; barbel relatively long, slender. Margin of preopercle broadly rounded, almost vertical posteriorly, preopercle ridge rounded at angle. Origin of V under posterior margin of preopercle; vent slightly removed from origin of A, under anterior ¼ of 1D. Posterior end of upper jaw below mid-orbit. Scale spinules 2–9, awl-shaped, erect to slightly reclined. Periproct small, slightly removed from A origin. Paired fins small, weak; 1D spine with weak, widely spaced denticles. (In part from Sazonov and Shcherbachev 1982:12–13.)

DISTRIBUTION.— Known from the holotype and 17 paratypes taken in the Indian Ocean and



FIGURE 22. *Pseudonezumia pusilla* (Sazonov, and Shcherbachev, 1982). ASIZP66424, 234 mm TL. A. fresh. B. lateral view of left head, preserved.

w. Pacific off New Guinea (Bismark Sea); one specimen from off the NW Cape of Australia; and the current Taiwan specimens from the South China Sea, which extend the range of the species into the w. North Pacific. Depth range 1098–2000 m; the Taiwan specimens represent the shallowest recorded at 1098 m.

REMARKS.— Shao et al. (2008: table 2) first recorded the Taiwan specimens as *Pseudonezumia cetonuropsis*, a species known only from the holotype and small paratype taken off central Japan. That species differs from *P. pusilla* in having a much shorter barbel (6% HL), longer snout (35%), and smaller orbit (27%).

Genus *Sphagemacrurus* Fowler, 1925

DISTINGUISHING FEATURES.— BR 7; ventral region of short head and short trunk shifted forward, gill membranes united under orbit, V usually under opercle, anus under origin of 1D, A origin under hind margin of 1D; snout blunt, high, tip of snout with small, spiny tubercle, on level with upper margin of pupil, naked areas, if present, confined to lower surfaces; jaws oblique; 1D spine with saw-tooth serrations on leading edge, 1D base somewhat elevated; naked periproct region broad, occupying $\frac{1}{3}$ or more of space between V and A, usually immediately before A origin; inner GR-I 15 or fewer; length barbel 1.7 to > 2.0 into orbit diameter. A well-developed sub-orbital shelf composed of two parallel rows of stout, spiny, modified scales. Body scales with 5–9 subparallel rows of short, awl-shaped, slightly reclined spinules.

REMARKS.— A small genus of six species, two of which are recorded from Taiwan. Iwamoto

and Williams (1999:211–212) noted differences in recorded values and features of specimens identified as *S. pumiliceps* from the Indian and Pacific oceans and stated that there are unresolved problems with the species in the genus. There is overlap in many characters between the *Sphagemacrurus* specimens we have examined, making identification difficult. The genus is in need of further study.

Key to the Species of *Sphagemacrurus* in Taiwan

- 1a. Rays of V 11–14; inner GR-I 8–11; barbel length 15–24% HL; interorbital width 23–28%. *S. pumiliceps*
 1b. Rays of V 9–11; inner GR-I 11–13; barbel length 13–16% HL; interorbital width 28–32% *S. richardi*

Sphagemacrurus pumiliceps (Alcock 1894)

Figures 23A–B.

Macrurus pumiliceps Alcock 1894:125 (Laccadive Sea; 1,315 m).

Lionurus pumiliceps: Gilbert and Hubbs, 1920:559, 560 (Philippine and East Indies, 732–1646 m).

Sphagemacrurus pumiliceps: Iwamoto, 1990:288 (in key).— Iwamoto and Merrett, 1997:549 (28 spec., sw. Pacific).— Iwamoto and Williams, 1999:210 (descr., 4 spec., Western Australia, 882–1880 m).— Merrett and Iwamoto, 2000:773 (24 spec., sw. Pacific).— Iwamoto et al., 2004:199 (1 spec., Walters Shoals, sw. Indian Ocean, 1310–1265 m).— Shao et al., 2008: table 2 (listed; Taiwan [ET, SCS], 736–1188 m).

MATERIAL EXAMINED (6 spec.).— **NET**: ASIZP 65551 (1, 36.9 HL, 265+ TL), CD 199, 1134–1188 m. **SCS**: ASIZP 65558 (1, 26.6 HL, 140+ TL), CD 134, 736–1040 m; ASIZP 66905 (3, 23.8–29.0 HL, 112+–202+ TL), CD 322, 1098 m.

DISTINGUISHING FEATURES.— 1D II,10–11; P i20–i23; V 11–14; inner GR-I 8–11 total; scale rows below 2D 7–10; pyl. caeca 10–12. Snout length 29–37% HL; interorbital 23–27%; orbit 31–37%; suborbital 18–21%; postorbital 40–44%; orbit-preopercle 36–43; upper jaw 36–39%; barbel 17–20%. Body relatively deep, about equal to HL; head about 7.5 in TL [all our specimens have a broken tail]; mouth rather small, upper jaw extends posteriorly to under midorbit; barbel well developed, about half diameter of orbit; underside of head mostly scaled except ventrally on snout and suborbital margin; body scales with short fine spinules arranged in about 5–8 parallel rows. Outer ray of V slightly prolonged, its tip extending to A origin or substantially beyond (to as far as 10th A ray). Periproct broad, abutting A origin posteriorly, spanning about 2/3 distance between V and A. Attains about 27 cm TL. (Data from Taiwan specimens only.)

DISTRIBUTION.— Widely distributed in the w. Pacific from se. Australia to Taiwan, in 732–1880 m; also found through most of Indian Ocean, where species was originally described. The ASIZ specimens, captured in 736–1188 m off Taiwan, were the first recorded from the area (Shao et al., 2008) and extend the range to n. of the Philippines.

REMARKS.— The reportedly wide distribution of this species and the variation in certain features found by Iwamoto and Williams (2001:211–212) suggest that more than one species may be currently recognized under this name.

Sphagemacrurus richardi (Weber, 1913)

Figures 24A–B.

Macrurus richardi Weber, 1913:154 (28 syntypes: FMNH 52442 ex cm 700 [1 spec.] Flores Sea; MOM 0091–1766 [1, disintegrated]; ZMA 110456 [1], 110447–49 [18, 1, 3], 110464 [1]; Makassar Strait; Celebes [Sulawesi] Sea; Ceram Sea; Flores Sea; *Siboga* sta. 85, 122, 170, 314, and 316; 538–1260 m).



FIGURE 23. *Sphagemacrurus pumiliceps* (Alcock, 1894). A. ASIZP 66905, 198 mm TL, fresh. B. ASIZP 65551, 265+ mm TL, preserved.

Sphagemacrurus richardi: Iwamoto, 1990:288, fig. 658 (in key).— Iwamoto and Williams, 1999:212 (mentioned).— Iwamoto and Graham, 2001:493 (56 spec., se. Australia; 880–1100m).

MATERIAL EXAMINED (6 spec.).— **SCS**: ASIZP 65621 (1, 29.3 HL, 176 TL), CD 203; ASIZP 66087 (1, 32.7 HL, 165+ TL), CD 320; ASIZP 66184 (1, 35.5 HL, 186+ TL), CD 320; ASIZP 66192 (1, 32.9 HL, 176 TL), CD 320; ASIZP 66910 (1, 34.5 HL, 190+ TL), CD 321; ASIZP 66944 (1, 127 TL), CD 321.

DISTINGUISHING FEATURES.— 1D II,9–10; P i19–i21; V 10–11(12); inner GR-I 11–14 total; scale rows below 2D 8–9; pyl. caeca about 10. Snout length 35–37% HL; interorbital 30–34%; orbit 28–34%; suborbital 19–21%; postorbital 40–43%; orbit-preopercle 40–41%; upper jaw 37–39%; barbel 13–16%. Body relatively deep, about equal to HL; head about 5.3–6.0 in TL; mouth rather small, upper jaw extends posteriorly to under midorbit; barbel well developed, about half orbit diameter; underside of head mostly scaled except ventrally on snout and suborbital margin; body scales with short fine spinules arranged in about 7–9 parallel rows. Outer ray of V slightly prolonged, its tip extending to or somewhat beyond A origin. Periproct broad, abutting A origin posteriorly, spanning about $\frac{2}{3}$ distance between V and A; anus closer to A than to outer base of V. Attains about 23 cm TL. (Data from Taiwan specimens only.)

DISTRIBUTION.— The ASIZ specimens captured in 634–954 m off Taiwan were the first recorded from the area (Shao et al. 2008) and extend the range to northward from Indonesia where it was first described.

REMARKS.— Our specimens represent the first record for Taiwan. In his original description of the species, Weber (1913) gave 8 as the count of V rays, but one of the current author's (TI) examination of what was probably the illustrated syntype (ZMA 110.456) had 10 rays in each fin. No other specimen of the species that we know of had such a low count, and we suspect it to be erroneous. *Sphagemacrurus decimalis* (Gilbert and Hubbs, 1920) has a low V count of 10, similar to *S. richardi*, but it differs in a number of morphometric features (as enumerated in the original description), including a somewhat lower count of rakers on the lower limb of GR-I (7 cf. 9–12); shorter snout (26–28% HL cf. 35–37%); shorter upper jaw (28–29% cf. 40–41%); shorter orbit-pre-



FIGURE 24. *Sphagemacrurus richardi* (Weber, 1913). A. ASIZP 66910, 190+ mm TL, fresh. B. ASIZP 65621, 176 mm TL, preserved, photo reversed laterally.

opercle distance 33–34% cf. 40–41%; and shorter barbel (9–11% cf. 13–16%). *Sphagemacrurus richardi* differs from *S. pumiliceps* in having slightly fewer V rays (10–11, rarely 12, vs. 11–14), shorter barbel (13–16% vs. 16–21%), and somewhat wider interorbital (30–34% vs. 24–28%) (*S. pumiliceps* data from Iwamoto and Graham 2001:493).

Genus *Spicomacrurus* Okamura, 1970

DISTINGUISHING FEATURES.— Snout low, pointed and slightly protruding, median and lateral processes of nasal bone forming broad horizontal plates; head about as broad as high; body and head cylindrical; head mucous canals moderately developed; head covering mostly transparent; light organ long, small lens on chest anterior to pelvic-fin bases connected by a black streak to elongated posterior lens immediately before anus; ventral striae well developed; inner GR-I, lower limb, 10–12; spinous ray of 1D completely smooth; chin barbel present; gular region with netlike epidermal cover; outer pelvic ray with narrow membranous flange that is somewhat expanded distally near tip.

REMARKS.— *Spicomacrurus* was originally treated as a subgenus of *Hymenogadus*, but Iwamoto et al. (2011) elevated the subgenus to full generic status. Although obviously related to members of the genera *Hymenocephalus* and *Hymenogadus*, the four species of *Spicomacrurus* are readily differentiated from them by the broad horizontal plates of their nasal bones, elongated posterior lens of the light organ, netlike gular covering, and membranous flange of the outer pelvic fin ray. *Spicomacrurus kuronumai* is the only member of the genus found in Taiwan.

***Spicomacrurus kuronumai* (Kamohara, 1938)**

Hymenocephalus kuronumai Kamohara, 1938:70, fig. 40 (Mimase, Kochi Pref., Japan; neotype: BSKU 4333, invalid according to ICZN).— Shao et al., 2008: table 2 (1 spec., NET, 100–650 m; first record from Taiwan).

Hymenogadus (Spicomacrurus) kuronumai: Okamura, 1970:64–67, pl. III, text-figs. 25, 26–28 (79 spec., 143–200 mm TL; Pacific coast of s. Japan, in about 350–450 m).

Hymenogadus kuronumai: Okamura in Masuda et al., 1984:94, pl. 80–I (compiled). Okamura in Okamura and Kitajima, 1984:203, 359, fig. 144 (p.202) (3 spec., 135–194 mm TL, Okinawa Trough [East China Sea], 400–510 m).

Spicomacrurus kuronumai: Iwamoto et al., 2011:513–530, fig. 1A–C (subgenus elevated to genus).

MATERIAL EXAMINED (2 spec.).— **NET**: ASIZP 65232 (1, 165 TL), Da-xi. ASIZP 70247 (1, 97 TL), Da-xi.

DISTINGUISHING FEATURES.— 1D II 9–12; P i18–i22; V 8; inner GR-I 12–15 total; pyl. caeca 11–18. Snout depressed, nasal bones developed into three horizontal platelike processes; body sub-cylindrical; outer V ray produced and expanded distally. Attains 240 mm TL.

DISTRIBUTION.— Pacific coast of s. Japan, and ne. Taiwan. in 350–650 m.

REMARKS.— Shao et al., (2008: table 2) first recorded the species from Taiwan based on ASIZP 65232. The species is apparently relatively abundant off Japan, as suggested by the 95 specimens (143–211 mm TL) recorded by Okamura (1970b:4, table 1), who treated it as a subgenus of *Hymenogadus*. Kamohara (1961) designated a neotype for the species but not in a revisory work, which renders the designation invalid (*fide* Eschmeyer 1998:852).

Genus *Trachonurus* Günther, 1887

DISTINGUISHING FEATURES.— BR 7; origin of V well behind P base and under posterior one-quarter of 1D base; V-A distance short, less than orbit diameter; broad periproct region spanning most of distance between V and A; second spinous ray of 1D smooth, rounded in cross-section, slightly longer than adjacent segmented ray; head smoothly rounded, without sharp ridges, almost fully scaled; scale patches usually present on branchiostegals; chin barbel short; body scales strongly adherent, with short, conical, relatively erect spinules; V 6 or 7; color uniformly gray to dark brownish black, fins dark, usually black.

REMARKS.— At least six species, two of which are found off Taiwan. The species in this genus are closely similar and differences between them are difficult to find. The widespread distributions reported for certain species (especially *T. villosus* and *T. sentipellis*) beg closer scrutiny.

Key to the Species of *Trachonurus* in Taiwan

- 1a. Body scales relatively large and coarsely spinulated; 8 or 9 scale rows between V base and gill cover *T. sentipellis*
 1b. Body scales smaller, finer spinulated; about 10–14 scale rows between V base and gill cover *T. villosus*

***Trachonurus sentipellis* Gilbert and Cramer, 1897**

Figures 25A–C.

Trachonurus sentipellis Gilbert and Cramer, 1897:429 (syntypes SU 3140 and USNM 51689; Hawaiian Is., 21°12'00"N, 157°38'30"W, *Albatross* sta. 3474, 375 fm [686 m]).— Iwamoto, 1997:945.— Iwamoto and Merrett, 1997:551.— Iwamoto and Williams, 1999:213 (descr., w. and se. Australia).— Merrett and Iwamoto, 2000:775 (6 spec., New Caledonia, 764–1,050 m).— Iwamoto and Graham, 2001:495 (3 spec., se Australia, 940–1130 m).— Shao et al., 2008: table 2 (7 spec., Taiwan [SWT, SCS], 441–1040 m).

MATERIAL EXAMINED (10 spec.).— **SWT:** ASIZP 64232 (2, 54.6–61.0 HL, 265+–295+ TL), CD 193, 821 m; ASIZP 65539 (1, 59.9 HL, 305 TL), CD 134, 736–1040 m; ASIZP 65543 (1, 150 TL), CD 138, 441 m; ASIZP 65544 (1, 175 TL) and ASIZP 65548 (1, 135 TL), CD 203, 634–866 m; ASIZP 65637 (1, 310+ TL), CD 229, 880–1062 m. **SCS:** ASIZP 66150 (1, 49 HL, 250+ TL), CD 321, 954 m; ASIZP 66743 (2, 21–32 HL, 105+–170+ TL), CD 320, 731 m.

DISTINGUISHING FEATURES.— 1D II,6–8; P 15–16 (rarely 18); V 7; total GR-I (inner) 11–13; scale rows below origin 2D usually 6–7, below midbase 1D 5–7; lateral line scales over distance equal to pre-1D length 26–34; scale rows between V base and gill cover 8–9; pyl. caeca 9–13, short, thick. Snout length 23–26% HL; interorbital width 26–33%; orbit diameter 27–37%; suborbital width 8–12; postorbital length 38–53%; orbit-preopercle 26–33; upper jaw 28–37%; barbel 8–11%; 1D-2D interspace 11–29%. Grooved lateral line present; body scales relatively large, coarsely covered with stout, erect spinules. Jaw teeth all small. Attains more than 31 cm TL. (Adapted from Iwamoto 1997.)

DISTRIBUTION.— Hawaii, Australia, New Caledonia, and Taiwan in 441–1130 m. Specimens from Taiwan were all taken from the South China Sea in 441–1040 m; they represent the first record of the species from the w. North Pacific.

REMARKS.— *Trachonurus sentipellis* is closely similar to *T. robinsi* Iwamoto, 1997 from the Philippines, but that species shows differences in some meristic values: P rays 10–14 vs. 15–16; inner GR-I 9–11 vs. 11–13; scales below 2D origin 4–6 vs. 5–8 (usually 6–7). Also, where *T. sentipellis* almost invariably has V 7, in *T. robinsi* the count is more often 6 than 7, and the maximum size in *T. robinsi* probably does not exceed 25 cm, whereas *T. sentipellis* exceeds 31 cm.

Trachonurus villosus (Günther, 1877)

Figure 26.

Coryphaenoides villosus Günther, 1877:441 (holotype BMNH 1887.12.7.105; s. of Tokyo, Japan).— Günther, 1887:142 (second specimen BMNH 1887.12.7.106 [non-type] from s. of the Philippines added).

Trachonurus villosus: Okamura in Masuda et al., 1984:95 (compiled).— Okamura in Amaoka et al., 1990:193.— Iwamoto, 1997:944–947 (comparison with *T. robinsi*).— Iwamoto and Williams, 1999:212 (mentioned).— Shao et al., 2008: table 2 (5 spec.; Taiwan [SCS], 634–954 m).

MATERIAL EXAMINED (4 spec.).— **SWT:** ASIZP 65626 (2, 175–255+ TL), CD 203, 634–866 m. **SCS:** ASIZP 66094 (1, 60 HL, 345+ TL) and ASIZP 66909 (1, 155+ TL), CD 321, 954 m.

DISTINGUISHING FEATURES.— 1D II,8; P 14–17; V 7; total GR-I (inner) 9–13; scale rows below origin 2D 5–9, usually 6–7, below midbase 1D 5–7; lateral line scales over distance equal to pre-1D length 26–34; scale rows between base of V and gill cover 10–14; pyl. caeca 9–13, short, thick. Grooved lateral line present; body scales relatively small, finely covered with erect spinules. Jaw teeth all small. Snout length 23–27% HL; interorbital width 31–34%; orbit diameter 29–30%; suborbital width 11–12%; postorbital length 38–42%; orbit-preopercle 29–33%; upper jaw 30–33%; barbel 6+–11%; 1D-2D interspace 20–22%. (Adapted from Iwamoto 1997.)

DISTRIBUTION.— Known from Japan to Taiwan and the Philippines. In Taiwan, specimens were taken from the South China Sea in 634–954 m.

REMARKS.— More specimens of this species must be examined from near the type locality off Japan to properly circumscribe the species and determine its difference from other described species.

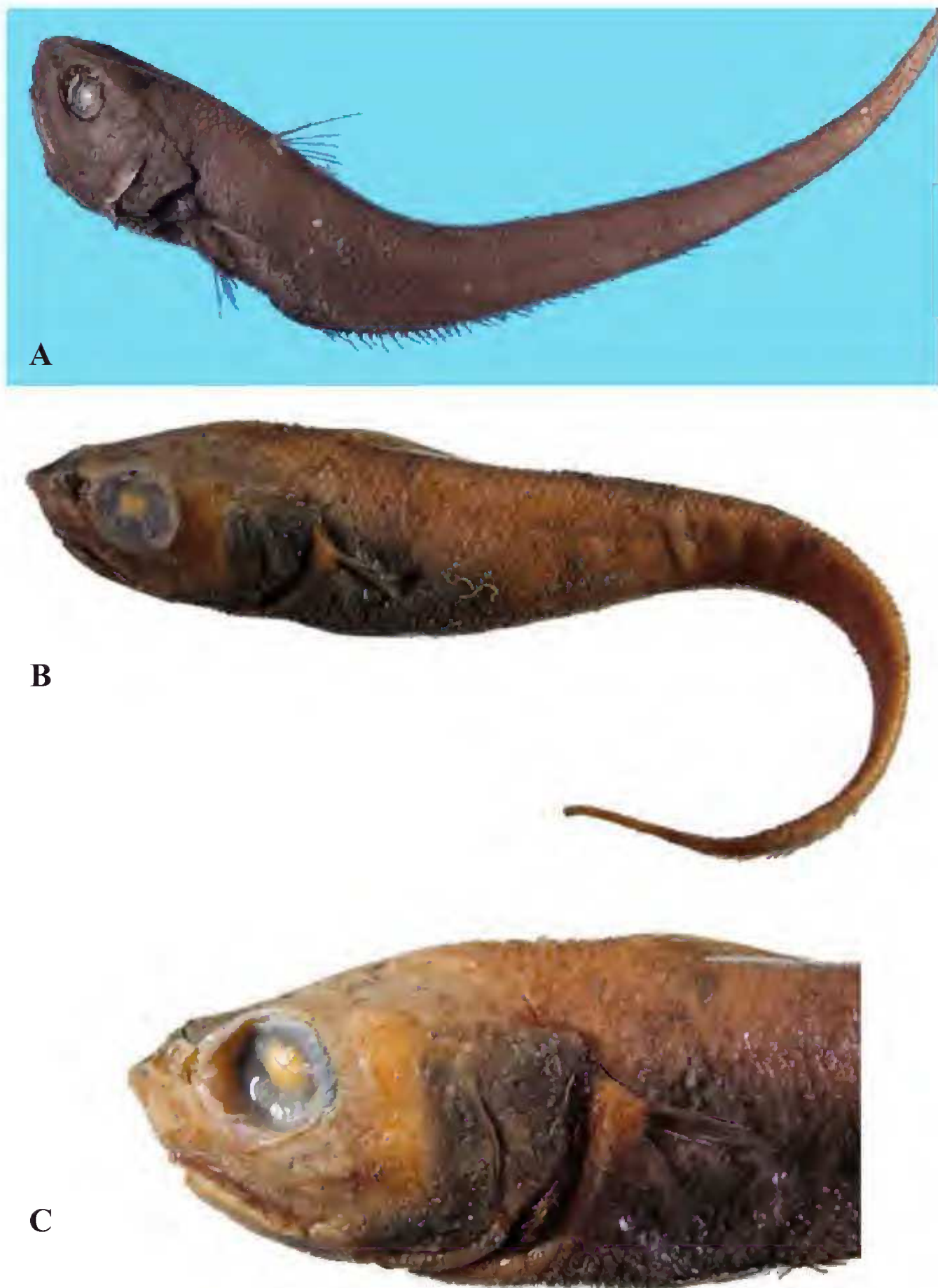


FIGURE 25. *Trachonurus sentipellis* Gilbert and Cramer, 1897. A. ASIZP 64232, 295+ mm TL. B. ASIZP 65539, 305 mm TL. C. ASIZP 65539, lateral view of right head, photo reversed laterally.

Genus *Ventrifossa* Gilbert and Hubbs, 1920

DISTINGUISHING FEATURES.— BR 7. Head and body relatively compressed; gill membranes narrowly united over isthmus and under midorbit; snout blunt to pointed and moderately protruding beyond mouth; tubercular scale lacking on snout tip except in *V. misakia*; no thickened modified scales on suborbital region; head uniformly and fully scaled except gular and BR membranes;



FIGURE 26. *Trachonurus villosus* (Günther, 1877). ASIZP 66909, 155+ mm TL. A. fresh. B. lateral view, preserved. C. dorsal view of head.

upper jaws generally more than 40% HL (35–42% in *V. misakia*), beset with long band of small teeth, outer series slightly enlarged; teeth on lower jaw all small, in one or two series to long narrow band; chin barbel usually well developed. Second spinous 1D ray smooth or finely serrated; V 8–10; no fin with greatly prolonged rays. Inner series GR-I 14–20 total. Periproct oval to teardrop shaped, connected anteriorly to small dermal window of light organ lying between V bases; anus much closer to V bases than to A origin. Pyloric caeca more than 30. Color often silvery along sides; lips usually black; leading edge of snout, suborbital shelf, dorsal snout ridges, gill and gular membranes usually black or blackish. (Adapted from Iwamoto and Graham, 2001:496.)

REMARKS.— There are more than 25 species in this genus; nine are here recorded from Taiwan. There are likely to be other species still undiscovered, especially in Indonesia and the Indian Ocean. Because of the often fragile nature of their integument and bones, smaller individuals of the genus are often severely damaged in capture. Features distinguishing species of *Ventrifossa* are often subtle, requiring relatively intact specimens, which add to the difficulties in their identification.

Key to the Species of *Ventrifossa* in Taiwan

- 1a. Second spinous ray of 1D smooth. 2
 1b. Second spinous ray of 1D finely serrated along leading edge 3
 2a. Pectoral fin long, 1.3–1.5 into HL; no enlarged spinules on scales along 2D base
 *V. macroptera*
 2b. Pectoral fin moderate to short, about 1.7 into HL; scales along 2D base with enlarged spinules
 *V. sazónovi*
 3a. Scales extremely small and finely spinulated, scaled surfaces almost velvety when stroked fore
 and aft; scale rows below 2D origin 9–10 a small tubercular scale at snout tip; suborbital shelf
 greatly constricted below anterior quarter of orbit *V. misakia*
 3b. Scales moderate in size with spinules of variable size, skin surface not velvety smooth; scale
 rows below 2D origin 5–8; no terminal snout scute; suborbital shelf not greatly constricted
 anteriorly 4
 4a. Spinules on body scales broad, short, and triangular (V 8–9, usually 8; 1D dusky to clear, with-
 out a distinct black blotch) *V. garmani*
 4b. Spinules on body scales narrowly lanceolate to conical (V 8–10; 1D dusky to blackish, some
 species with a black blotch) 5
 5a. Body color uniformly brown except swarthy over abdomen (underlain by bluish) and no silvery
 reflections, suborbital uniformly dark brown, no black shelf; snout rather blunt in lateral view,
 scarcely protruding beyond mouth *V. saikaiensis*
 5b. Body color light grayish-brown dorsally, silvery along sides, suborbital with black shelf; snout
 moderately pointed to rather blunt and prominently to scarcely protruding beyond mouth. . 6
 6a. Barbel less than 24% of HL; lateral-line scale rows 43 or less; 1D with prominent black blotch
 or broad midlateral streak 7
 6 b. Barbel 25% or more of HL; lateral-line scale rows 45 or more; 1D uniformly dusky or with
 midlateral black streak 8
 7a. Rays of V 9 or 10; mesial GR-I 15–17 total, lateral GR-II 14–17 total; length upper jaw usual-
 ly 43–46% HL; black distal margin anteriorly on A fin *V. rhipidodorsalis*
 7b. Rays of V 8 or 9; mesial GR-I 13–15 total, lateral GR-II 12–14 total; length upper jaw 40–43%
 HL; no black margin on A fin. *V. nigrodorsalis*
 8a. 1D usually uniformly dusky or somewhat darker proximally. *V. divergens*
 8b. 1D dark or black midlaterally, distally pale or dusky *V. longibarbata*

Ventrifossa divergens Gilbert and Hubbs, 1920

Figure 27.

Ventrifossa divergens Gilbert and Hubbs, 1920:549 (holotype, USNM 78230, Celebes Sea near Sibuko Bay, Borneo, 4°12'44"N, 118°27'44"E, *Albatross* sta. 5592, 305 fm [558 m]; 59 paratypes).— Iwamoto, 1990: 299–300, fig. 676–677 (descr.).

MATERIAL EXAMINED (21 spec.).— **SWT:** ASIZP 66928 (1, 62 HL, 320+ TL), PCP 339, 846 m; ASIZP 66255 (1, 67 TL), OCP 303, 807 m. **SCS:** ASIZP 66781 (4, 59–64 HL, 297+–330+ TL), and ASIZP 66782 (2, 58–59 HL, 275+–310+ TL), CD 320, 731 m; ASIZP 66784 (2, 41–47 HL, 205+–217+ TL), OCP 317, 515 m. **Other specimens** (all from *Albatross* Philippines Expedition of 1907–1909): **Indonesia:** USNM 78230 (holotype, 48.4 mm HL, 271 mm TL). USNM 122917 (paratypes, 3, 34.2–40.3 HL), Molucca Sea, 545 m, sta. 5621. **Philippines:** USNM 122916 (paratypes, 2, 142+–469+ TL), off ne. tip of Luzon, 410 m, sta. 5325; USNM 122919 (41.5 HL,



FIGURE 27. *Valtrifossa divergens* Gilbert and Hubbs, 1920. ASIZP 66928, 320+ mm TL, fresh. B. ASIZP 66781, 292+ mm TL, preserved, photo reserved laterally.

222 TL), off ne. Mindoro, 623 m. USNM 148988 (paratype, 53.0 HL, 281 TL), off Balayan Bay, Batangas, sw. Luzon, sta. 5116 or 5115. USNM 149361 (paratype, 24.7 HL, 140 TL), off sw. Luzon, 315 m, sta. 5289. USNM 149363 (paratype, 53.2 HL, 250 TL) and USNM 150400 (paratype, 19.5 HL, 105 TL), off sw. Luzon, 391 m, sta. 5290.

DISTINGUISHING FEATURES (from 11 USNM specimens, holotype data with asterisk*).— 1D II,9–11(10*); P i18–i25 (21–22*); V 8*–9; total GR-I (mesial) (12*)15–18, GR-II (lat.) 14*–15(17); scale rows below 1D 10–12, below midbase 1D (10*), below 2D 8–9* (11); lateral line scales over distance equal to predorsal length (48*). Snout length (29*) 26–31% HL; preoral length (15*) 14–19%; internasal 19*–25%; interorbital (24*) 30–37%; orbit (31*) 30–38%; suborbital (11*) 13–15%; postorbital (44*) (38) 41–47%; orbit to preopercle (45*) 40–46%; upper jaw 43*–49%; barbel (28*) 26–35%; outer gill slit (19*) 24–28%. Color in alcohol silvery on sides, brown dorsally but darker anteriorly, blackish ventrally on head and trunk; lips, lower jaw and gill membranes black; leading edge of snout blackish; mouth and gill cavity as in others of genus; 1D dusky proximally, paler distally; V dusky to black; base and axil of P black. Attains more than 47 cm TL.

DISTRIBUTION.— From South China Sea off Taiwan and Hong Kong; Philippines (e., n. and w. Luzon, off n. Mindoro, Sulu Sea off Panay); Celebes Sea off e. Borneo; Molucca Sea off Halmahera. Depth range about 183 to 807 m. Records of the species from s. Africa were misidentifications of a species that was subsequently described as *V. mystax* Iwamoto and Anderson, 1994.

REMARKS.— Chiou et al., (2004b:46, fig. 19) recorded this species from Taiwan based on two specimens, ASIZP 61309 and 61310, which we re-identified as *V. saikaiensis*. However, new specimens were collected off Taiwan at depths of 515–807 m. Based on examination (by TI) of many

USNM specimens, there may actually be more than one species represented in the type series. The holotype (USNM 78230) had several characters that appeared to be outside the normal range of other specimens. These characters include a low GR-I count of 12 total (mesial side) cf. 15–18 in others examined, narrower interorbital (24% cf. 26–32%), narrower suborbital (11% cf. 13–15%); shorter upper jaw (43% cf. 43–49%); and shorter outer gill slit (19% cf. 24–28%). Other measurements appear to be at one or another extreme in the range. The relatively sharply pointed snout and high anterior dorsal profile also differ in degree with other specimens. Among other *Ventrifossa* species from Taiwan, the one most similar is *V. longibarbata*, and so far as our limited study material allow, the two species overlap or are essentially identical in their counts and measurements. The snout in *V. divergens* appears to be slightly more pointed and protruding, and the broad black stripe across the 1D in *V. longibarbata* is generally prominent, compared to the diffuse duskiess of that fin in *V. divergens*. A more in-depth study may reveal other distinguishing characters. The overall brownish color of *V. saikaiensis*, its longer postorbital length (44–49% HL), and fewer scale rows below the 2D (6.0–6.5 cf. 8–9 in *V. divergens*), among other characters, distinguish that species from *V. divergens*. Compared with *V. rhipidodorsalis*, *V. divergens* has a longer preoral (15–19% cf. 11–15% of HL), somewhat broader interorbital (26–32% cf. 21–26%), somewhat larger orbits (with overlap, 29–38% cf. 27–32%), and somewhat shorter postorbital (with overlap, 38–44% cf. 43–48%); *V. rhipidodorsalis* also has a somewhat higher average number of V rays (9–10) and more prominent black blotches on 1D.

Ventrifossa garmani (Jordan and Gilbert, 1904)

Figures 28A–B.

Coryphaenoides garmani Jordan and Gilbert in Jordan and Starks, 1904:610 (holotype USNM 50933, Sagami Bay, Japan, 110–259 fm [201–474 m]; paratypes ANSP 114108 [1 spec.], CAS-SU 8548 [5 spec.], USNM 51415 [9 spec.]).

Ventrifossa garmani: Matsubara, 1955:1315.— Kamokara, 1964:96.— Okamura, 1970:74.— Iwamoto, 1979:152.— Okamura in Okamura et al., 1982:145, 348.— Okamura in Masuda et al., 1984:94.— Okamura in Okamura and Kitajima, 1984:213, 360.— Iwamoto, 1990:300–301, fig. 678–679 (descr.).— Shen et al., 1993:172 (desc.).— Chiou et al., 2004b:37, 47 (in key, list).— Shao et al., 2008: table 2 (2 spec., SWT).

MATERIAL EXAMINED (8 spec.).— **SWT**: ASIZP 61306 (1, 260+ TL), Dong-gang. ASIZP 65586 (1, 235 TL), CD 140, 280–452 m. **Other materials: Japan**: USNM 50933 (holotype, 52.8 HL, 292 TL), *Albatross* sta. 3695, Sagami Bay, 201–474 m. USNM 51415 (5 of 9 paratypes, 32–46.1 HL, 180–250+ TL), Suruga Bay, *Albatross* sta. 3738, 305 m.

DISTINGUISHING FEATURES.— 1D II,10–11; P i19–i22; V 8, rarely 9; inner GR-I 16–17 total, outer GR-II 16–17; scale rows below midbase 1D 7.5–9.0, below 2D 4.5–5.0; lateral line scales over distance equal to predorsal length 38–42. Snout length 25–27% HL; preoral length 18–19%; interorbital 29–32%; orbit 30–35%; suborbital 11–15%; orbit to preopercle 41–45%; upper jaw 42–47%; barbel 23–29%; outer gill slit 24–27%. Head and body relatively compressed; snout relatively short, high, forming obtuse angle viewed dorsally. Body scales covered with broad-based, triangular spinules in quincunx arrangement. Spinous ray of 1D usually less than HL, leading edge finely sawtoothed. Periproct occupying about half anterior space between V and A, close behind V bases, dermal window of light organ extends forward between V bases. Gill membranes narrowly united over isthmus and under midorbit. Color in preservative light to medium gray-brown overall, silvery over most of head, trunk, and anteriorly on sides of tail, but not over dorsum; jaws, gill membranes, and below suborbital ridge blackish; mouth pale, gill cavities blackish posteriorly; leading edge of snout blackish; 1D dusky, somewhat darker midlaterally; V blackish; P and A clear to dusky. Attains about 30 cm TL.



FIGURE 28. *Ventrifossa garmani* Jordan and Gilbert, 1904. ASIZP 61306, 260+ mm TL, preserved. A. lateral view of whole fish. B. lateral view of right head, photo reversed laterally.

DISTRIBUTION.— From s. Japan to sw Taiwan [SCS], in 280–452 m.

REMARKS.— This is one of the most abundant species of macrourid in Japan, but it is not particularly common off Taiwan. The broadly triangular scale spinules on body scales are unique among the Taiwan members of this genus.

***Ventrifossa longibarbata* Okamura, 1982**

Ventrifossa longibarbata Okamura in Okamura et al., 1982:157–159, pl. 94 (holotype BSKU 29494; Tosa Bay, Japan, 32°58.0'N, 133°32.0'E, 605 m; 4 paratypes, Tosa Bay, Suruga Bay, and Okinawa Trough, in 382–620 m).— Okamura in Masuda et al., 1984:94.— Okamura in Okamura and Kitajima, 1984:215, 361.— Iwamoto and Williams, 1999:228 (comparisons with *V. nigrodorsalis* et al.).— Chiou et al., 2004b:48, fig.20 (2 spec.; sw. Taiwan).

MATERIAL EXAMINED (45 spec.).— **NET:** ASIZP 65609 (1, 301 TL), CD 209, 508–522 m; ASIZP 70242 (1, 133 TL), Da-xi. **SWT:** ASIZP 61242 (1, 272 TL), Dong-gang; ASIZP 61243 (2, 182–268 TL), Dong-gang and CAS 224884 [ex ASIZP 61243] (1, 238+ TL), Dong-gang; ASIZP 64114 (5, 185–225+ TL) and ASIZP 66950 (5, 53–55 TL), CD 194, 507 m; ASIZP 65532 (1, 290 TL) and ASIZP 65556 (1, 180 TL), CD 137, 316–477 m; ASIZP 65602 (1, 185 TL), CD 138, 441 m; ASIZP 65629 (1, 155 TL), CD 233, 448–526 m; ASIZP 65537 (1, 260 TL), CD 133, 690–748 m. **SCS:** ASIZP 66102 (1, 58 HL, 285+ TL), CP 315, 509 m; ASIZP 66257 (1, 35.5 HL, 155+ TL), ASIZP 66267 (1, 31.6 HL, 140+ TL), and ASIZP 66779 (7, 23–36 HL, 110+–180+ TL), CD 311, 516 m; ASIZP 66948 (2, 150–210 TL), CD 136, 998–1211 m; ASIZP 66263 (1, 37 HL, 200+ TL), CD 310, 364 m; ASIZP 66749 (3, 25–31 HL, 110+–170+ TL),) and ASIZP 66778 (2, 30–37 HL, 150+–160+ TL), CP 314, 506 m; ASIZP 66777 (2, 145–145+ TL, 24–30 HL; CP 313, 513 m;

ASIZP 66812 (2, 24–25.5 HL, 120+–130+ TL), OCP 317, 515 m; ASIZP 66829 (2, 100+–130+ TL), CP 315, 509 m.

DISTINGUISHING FEATURES (data from six Taiwan specimens).— 1D II,10–11; P i18–i21; V 8–9; total GR-I (lat/mesial) 10–12/15–17, GR-II 14–17/14–16; scale rows below midbase 1D 4.5–7.5, below 2D 5.0–6.5(9.0); lateral line scales over distance equal to predorsal length 37–41. Snout length 26–28% HL; preoral length 16–17%; interorbital 25–31%; orbit 29–36%; suborbital 12–14%; postorbital 42–48%; orbit to preopercle 41–46%; upper jaw 40–47%; barbel 28–39%; outer gill slit 26–28%. Color in life (from Okamura *in* Okamura et al., 1982:159) dark gray or swarthy dorsally, silvery on sides of head and body, black over gular region, lips, lower jaw, gill membranes, chest and ventrally on trunk; abdomen bluish under silvery reflections, suborbital region and ventral and posterior margin of gill cover blackish; mouth pale, gill cavities blackish posteriorly; leading edge of snout blackish; 1D with wide dusky to blackish midlateral section, but pale distally and along base; V black; P blackish; base of P silvery but with black distal edge and mesial lunate area. Attains at least 31 cm TL.

DISTRIBUTION.— From s. Japan to Taiwan (SWT) and South China Sea in 382–1211 m.

REMARKS.— This species closely resembles *V. garmani* in general physiognomy but differs in having a slightly longer barbel (28–39% HL vs. 21–29%), a darker midlateral region of 1D, more pyloric caeca (about 70 vs. <53 *vide* Okamura 1970:77), slender scale spinules (vs. triangular), and possibly darker V (black vs. dusky or blackish) and P (which appears to be blackish in Okamura's [*in* Okamura et al., 1982:156] photograph of the holotype vs. "light" in *V. garmani* [Okamura, 1970:77]). The six Taiwan specimens from which the above measurements and counts were taken agree closely with the original description of *V. longibarbata* except for slight differences in interorbital width (25–31% HL cf. 21–26.5%), postorbital length (42–48% cf. 39–44%), P ray count (i18–i21 cf. i21–i26"), and scale rows (below 1D origin 7–12 cf. 12–14, below mid-base 1D 4.5–7.5 cf. 8.5–11.5, and below 2D origin 5.0–9.5 cf. 9.0–10.0). The 1D was also almost entirely dusky, with only faint trace of a midlateral stripe. Four additional examples taken off Kochi, Japan (BSKU 12919, 12920, 12922, and 12923) were examined by TI many years ago; they agree well with the original description of the species.

Ventrifossa macroptera Okamura, 1982

Ventrifossa macroptera Okamura *in* Okamura et al., 1982:149 (holotype BSKU 32185, Kyushu-Palau Ridge, 27°55.1'N, 134°44.8'E, 685–710 m; paratypes BSKU 30432 [1 spec.], 30435–36 [2], 30467–69 [3], 29429 [1], 32153–84 [31], 32186–89 [4], 32192–200 [8]).— Okamura *in* Masuda et al., 1984:94 (compiled).— Iwamoto, 1990:303, figs. 682–683 (descr.).— Chiou et al., 2004:48, fig. 21 (2 spec.; Tung kang, Taiwan [SWT]).

Ventrifossa atherodon (not of Gilbert and Cramer, 1897): Chiou et al., 2004b:46, fig. 18 (ASIZP 61311 (1 spec., Da-xi, Taiwan [NET])).

MATERIAL EXAMINED (103 Taiwan spec.).— **NET**: ASIZP 60253 (1, 286 TL), Da-xi; ASIZP 65533 (1, 190 TL), CD 210, 445–1185 m; ASIZP 61311 (1, 245 TL), Da-xi; ASIZP 70682 (1, 47 HL), Da-xi; ASIZP 70729 (1, 254 TL), Da-xi. **SWT**: ASIZP 61244 (1, 199 TL), Dong-gang; ASIZP 61245 (1, 202 TL), Dong-gang; ASIZP 65525 (3, 170–190 TL), CD 142, 227–335 m; ASIZP 66947 (2, 235–250 TL), CD 140, 280–452 m; ASIZP 67596 (3, 118–143 TL), CP 348, 395 m; ASIZP 70254 (1, 180 TL), Dong-gang. **SCS**: ASIZP 65522 (18, 90–185 TL), ASIZP 65590 (41, 143–221 TL), ASIZP 65612 (5, 175–225 TL), and ASIZP 65614 (4, 111–132 TL), CD 136, 998–1211 m; ASIZP 65534 (1, 280 TL), CD 137, 316–477 m; ASIZP 65623 (1, 208 TL), CD 233, 448–526 m; ASIZP 65640 (1, 218 TL), CD 233, 448–562 m; ASIZP 65679 (1, 21 HL, 97+ TL), CP 315, 509 m; ASIZP 66751 (1, 125 TL), OCP 312, 517 m; ASIZP 66764 (2, 35–38 HL, 130+–160+

TL), CP 314, 506 m; ASIZP 66798 (6, 20–38 HL, 110–180+ TL), CD 311, 516 m; ASIZP 66804 (2, 125–255 TL), OCP 317, 515 m; ASIZP 66808 (1, 180 TL), CP 314, 506 m; ASIZP 66832 (1, 143 TL), CP 315, 509 m; ASIZP 66949 (2, 130+–144 TL), CP 234, 547 m.

Other specimens: Japan (all from Kyushu-Palau Ridge). HUMZ 75049 (330+ TL); 75050 (325+ TL); 75051 (328+ TL); 75052 (332+ TL); 75053 (250+ TL); 75054 (338+ TL); 75055 (290+ TL); 75056 (356+ TL); 75057 (295 TL). CAS 52971 (3 paratypes, ex. BSKU spec.; 60.0–73.0 HL, 290+–376+ TL); CAS 52972 (7 paratypes, ex. BSKU; 58.2–70.3 HL, 235+–360+ TL).

DISTINGUISHING FEATURES.— 1D II,9–10(11); P i19–i23; V 9–10; GR-I (outer/inner) (10) 13–15 / 16–18 total, GR-II (outer/inner) 16–18 / 16–18; scale rows below 1D origin 9.5–11.0 (12.0), below midbase 1D 6.0–7.5, below 2D 7.5–10.0; lateral line scales over distance equal to predorsal length 48–57. Snout length 27–32% HL; preoral length 12–17%; internasal 23–27%; interorbital 29–32%; orbit 26–31%; suborbital 12–15%; postorbital 42–48%; orbit to preopercle 45–52%; upper jaw 47–51%; barbel 20–27%; outer gill slit 26–33%. Second spinous ray of 1D smooth. Snout rather blunt, little protruding beyond mouth; suborbital shelf narrowly constricted anteriorly below posterior nostril. Premaxillary tooth band broad; outer series of recurved, canine-like teeth with arrowhead-shaped tips; lower jaw teeth in two series. Color overall dark, head swarthy to black, somewhat silvery on sides of head and body, blackish over gular region and chest, de-scaled areas on trunk and anterior part of tail bluish; mouth pale, gill cavities blackish posteriorly; gill arches dark; leading edge of snout blackish; fins blackish; broad lunate area mesial to P base black. Attains about 40 cm TL.

DISTRIBUTION.— Kyushu-Palau Ridge to Taiwan and the South China Sea. In Taiwan, specimens were collected off NET, SWT, and SCS, mostly at depths between 280 and 516 m, but one collection (CD 136) from 998–1211 m.

REMARKS.— Chiou et al. (2004b:46, fig. 18) recorded a specimen referred to *V. atherodon* that is now re-identified as *V. macroptera*. Okamura (*in* Okamura et al. 1982:151) considered this species to be the most dominant of the grenadiers off the Kyushu-Palau Ridge. It appears to be similarly abundant in the South China Sea. In respect to the smooth spinous 1D ray, the low blunt snout, and dentition, *V. macroptera* resembles *V. atherodon* (Gilbert and Cramer, 1897), *V. macrodon* Sazonov and Iwamoto, 1992 from the se. Pacific, and *V. sazonomi* Iwamoto and Williams, 1999 from w., nw., and ne. Australia and the South China Sea. The last species is notable in having enlarged spinules on scales of the dorsum below the anterior portion of the 2D.

***Ventrifossa misakia* Jordan and Gilbert, 1904**

Figure 29.

Coryphaenoides misakius Jordan and Gilbert, 1904:611–612 (holotype, CAS-SU 8107, 340 mm TL; Misaki, Japan).

Macrourus asper (not of Günther): Jordan and Thompson, 1914:306, pl. 38, fig. 2 (“Misaki in deep water;” no description.)

Lionurus misakius: Gilbert and Hubbs, 1916:194–195 (1 spec., 113+ mm TL).

Ventrifossa misakia: Okamura, 1970:78–81, pl. VI, text-fig. 35 (47 spec., 150–260 mm TL; s. Japan).— Iwamoto, 1990:304–305, fig. 684–685 (descr.).— Sazonov and Shcherbachev, 1997:529–533 (comparisons; synonymized *V. fusca* with *V. misakia*).— Nakabo, 2002:423 (compiled).

Ventrifossa fusca Okamura *in* Okamura et al., 1982:153–155, fig. 93, A–D (p. 152) (holotype, BSKU 26067, female, 612 mm TL; Kyushu-Palau Ridge, 27°55'N, 134°39'E, 700 m; paratypes [same locality], BSKU 26068 [female, 526 TL], 26069 [male, 434+ TL], 26115 [male, 468 TL]).— Okamura *in* Masuda et al., 1984:94, pl. 81–B (compiled).— Nakabo, 2002:422 (compiled).— Shao et al., 2008 (6 spec., SCS; first record for Taiwan).

MATERIAL EXAMINED (6 spec. from Taiwan).— **SCS:** ASIZP 66783 (6, 157–380+ TL), CD 320, 731 m. **Other specimens: Japan:** CAS-SU 8107 (holotype, 60 HL, 340 TL), Sagami Bay near Misaki, Japan. USNM 51421 (3 paratypes, 54–76 HL, 165+–380 TL), Misaki. BSKU 12002 (1, 50 HL, 240 TL); Tosa Bay. BSKU 12953 (1, 46 HL, 225+ TL), Tosa Bay. BSKU 12955 (1, 28 HL, 157 TL). NSMT P49952 (1, 42.7 HL, 198+ TL), Suruga Bay, 440 m. NSMT P78960 (1, 44.3 HL, 230+ TL) and P78961 (1, 43.0 HL, 230+ TL), Suruga Bay, 376 m. FAKU 5270 (1, 36.8 HL, 197+ TL), M7634 (1, 42 HL, 221 TL), M7651 (1, 38 HL, 190+ TL), and M7655 (39.5 HL, 194 TL), Chiba Pref., off Choshi.

DISTINGUISHING FEATURES.— 1D II,10–12; P i19–i23; V 8 (rarely 9); total GR-I (lateral/mesial) 11–12 / 13–16 total, (lateral/mesial) GR-II 14–15 / 12–15; scale rows below mid-base 1D 8.5–10.5, below 2D 9–10; lateral line scales over distance equal to predorsal length 57–76. Snout length 27–33% HL; preoral length 20–27%; internasal 22–29%; interorbital 29–35%; orbit 32–38%; postorbital 36–44%; orbit to preopercle 40–45%; suborbital 12–15%; upper jaw 37–42%; barbel 4–9%; outer gill slit 18–24%; 1D-2D interspace 40–56%. Head broad, body relatively compressed; snout conical, protruding well beyond mouth, with a small tubercle at tip; suborbital area gently rounded, ridge defined but lacking stoutly modified scales, suborbital shelf abruptly constricted anteriorly; head fully scaled, but lacking large pores; body scales covered with slender, needle-like spinules in quincunx pattern. Color in alcohol light to medium gray-brown with silvery reflections along sides; bluish black over abdomen and chest; gill cover and gill membranes blackish; mouth and gill cavities pale, but blackish posteriorly; tip of snout (and in young along leading edge) blackish; 1D dusky, V black, P and A dusky. Attains about 40 cm TL.

DISTRIBUTION.— From se. coast Japan to the East China Sea and South China Sea off sw. Taiwan, in 200 to 731 m.

REMARKS.— We have been informed by Dr. Hiromitsu Endo of Kochi University that specimen BSKU 28596 recorded by Okamura (*in* Okamura and Kitajima 1984:213) as *V. misakia* is actually a specimen of *V. johnboborum*. We follow Sazonov and Shcherbachev (1997:529) in synonymizing *V. fusca* Okamura with *V. misakia*. It is rather peculiar that Okamura (*in* Okamura et al. 1982) failed to recognize specimens of his new species as representing *V. misakia* or a species very similar, knowing that he had examined many specimens of *V. misakia* for his work on the Japanese macrourids in the *Fauna Japonica* book series (Okamura 1970:78) and treating both species in



FIGURE 29. *Ventrifossa misakia* Jordan and Gilbert, 1904. ASIZP66783, 1 of 6, 380+ mm TL, preserved.

Masuda et al. (1984). The first author (TI) has examined two paratypes of *V. fusca* (BSKU 26068, 99 mm HL, 526 mm TL, and 26069, 106 HL, 434+ TL [large pseudocaudal]), both of which are much larger than any other we have seen. They are nonetheless identical in every feature with our smaller Tawian representatives of *V. misakia*, so far as we can tell. Sazonov and Shcherbachev (1997:532) pointed out that Okamura compared his species with *Kuronezumia macronema* (Smith and Radcliffe, 1912), a very different species that has been classified in another genus. The close similarity of *V. misakia* and *V. johnboborum* Iwamoto, 1982 was also recognized by Iwamoto (1982:59–60; 1990:305) and Sazonov and Iwamoto (1992:80). Sazonov and Shcherbachev (1997:529) compared specimens of *V. johnboborum* from the w. Indian Ocean, e. and w. Australia, the South China Sea, the Sala y Gomez Ridge (se. Pacific), and the holotype taken in the Bismarck Sea. They found these populations “differing in a few morphometric indices while retaining several common characters not peculiar to *V. misakia* (including *V. fusca*).” Among the different populations, that from the South China Sea was most similar to *V. misakia*, but they were unable to arrive at any conclusions as to “the independence of *V. johnboborum*.” Accordingly, we continue recognition of *V. johnboborum* while awaiting a more detailed analysis, perhaps using DNA information. Our specimens represent the first record of *V. misakia* from Taiwan and the South China Sea and also the deepest record at 731 m.

***Ventrifossa nigrodorsalis* Gilbert and Hubbs, 1920**

Ventrifossa nigrodorsalis Gilbert and Hubbs, 1920:546 (holotype, USNM 83627; n. coast Mindanao, Philippines, 391 m; 168 paratypes from Formosa [Taiwan], Philippines, and East Indies, 290–868 m). Iwamoto, 1990:307–309, fig. 690 (descr.).—Iwamoto and Merrett, 1997:559 (New Caledonia and vicinity).—Iwamoto and Williams, 1999:224–225, 228, fig. 54 (descr., e. and w. Australia).—Iwamoto and Graham, 2001:497–498, fig. 112 (descr., se. Australia, 300–790 m).—Chiou et al., 2004b:47 (listed, Taiwan, Table 1).

MATERIAL EXAMINED (3 Taiwan spec.).—**NET:** ASIZP 66903 (1, 197 TL), CP 248, 536 m; ASIZP 70715 (1, 188 TL), Da-xi. **SCS:** ASIZP 57974 (1, 183+ TL), Tong-sa Islands. **Other specimens:** USNM 8362 (holotype, 41.5 HL, 214 TL), Philippines, Mindanao Sea; 8°37'37"N, 124°35'E, 391 m, *Albatross* sta. 5502, 4 Aug. 1909. USNM 149302 (paratypes, 4, 32.3–36.0 HL, 125+–195+ TL), same data as for holotype; CAS 64574 (5, 30–9–36.6 HL, 499+–193+ TL), SCS off Vietnam; 15°40'00"N, 109°47'E, 479 m. CAS 221057 (38.5 HL, 210+ TL), Philippines, e. coast Luzon, 14°41'04"N, 123°24'07"E, 435–451 m, *Fishery Researcher I*, field no. TI95–12, 27 Sept. 1995.

DISTINGUISHING FEATURES.—1D II,9–10; P i19–i23; V 8–9; total GR-I (lateral/mesial) 9–13/13–15, GR-II 13–14 /13–14; scale rows below 1D 8–9, below 2D 7–9; lateral line scales over distance equal to predorsal length 36–43. Snout length 29–30% HL; preoral length 19–21%; internasal 22–23%; interorbital 23–28%; orbit 28–34%; postorbital 42–44%; orbit to preopercle 39–42%; suborbital 13–16%; upper jaw 37–41%; barbel 17–26%; outer gill slit 21–25%; 1D-2D interspace 39–66%. Body and head moderately deep and compressed, nape somewhat elevated; snout slightly protruding beyond mouth, acutely pointed in lateral view, broadly obtuse in dorsal view. Body scales covered with small, needle-like spinules in wide chevron-like rows; small area of spinuleless scales along and behind 1D base. Color in alcohol grayish-brown dorsally on trunk, becoming paler along 2D base to form a dorsolateral stripe on tail; top of head and snout pale, integument translucent; faint silvery reflections along sides of head and ventrally on trunk and tail; underlying silvery pigmentation abdomen and chest bluish-black, tail pale with light peppering; gill cover and gill membranes mostly black; mouth and gill cavities pale, but dark in gullet; black margins on suborbital shelf, leading edge of snout, and supranarial ridges; 1D with black blotch or

blackish over middle third or so of fin but pale distally and along base; V black, sometimes paler distally and near base; P and A dusky, but base of P black with lateral surface mostly silvery. Lips, jaws, and gill cavity as in others of genus. Attains about 25 cm TL in Taiwan region, possibly more elsewhere.

DISTRIBUTION.— Known from off Australia, New Caledonia region, and Indonesia n. to the Philippines, Taiwan (NET), and the South China Sea.

REMARKS.— Okamura (*in* Okamura et al. 1982:147, 348, fig. 90) initially recorded this species from two specimens collected in Tosa Bay. He later (Okamura et al. 1984) treated those specimens as representatives of his new species *V. rhipidodorsalis*, and used the photograph of one of the specimens (fig. 146C; BSKU 29495, 172 mm TL) to illustrate another example of the new species. *Ventrifossa nigrodorsalis* is an apparently broadly distributed species abundant in the Philippines, Indonesia, and the warm-water regions of Australia, as well as the sw. Pacific off New Caledonia, Vanuatu, and near regions, but it was scarce off Taiwan. Characters that have been used to distinguish species of *Ventrifossa* are often subtle and dependent on well-preserved specimens to observe. The existence of seemingly widely scattered populations of *V. nigrodorsalis* heighten the possibility that other species lie hidden under the cloak of that species name as currently circumscribed, and they may be unveiled after closer study of more specimens. The description provided above is from specimens collected off Taiwan, the South China Sea, and the Philippines in the Mindanao Sea between Mindanao and Cebu.

Ventrifossa rhipidodorsalis Okamura, 1984

Ventrifossa rhipidodorsalis Okamura *in* Okamura and Kitajima, 1984:205 (Okinawa Trough, 28°42.0'N, 127°09.0'E, 500–535 m (holotype, BSKU 27695; 23 paratypes, Okinawa Trough and Tosa Bay, 500–650 m [but 1 spec. at 220 m]).— Okamura *in* Masuda et al., 1984:94 (compiled).— Iwamoto and Williams, 1999:228 (mentioned).— Chiou et al., 2004b:48, fig.22 (13 spec.; Nanfangao, Taiwan [NET]).

? *Ventrifossa nigrodorsalis*: Okamura *in* Okamura et al., 1982:147, 348, fig. 90 (2 spec.; BSKU 29495, later identified as *V. rhipidodorsalis* by Okamura *in* Okamura and Kitajima, 1984: fig. 146C).

MATERIAL EXAMINED (70 Taiwan spec.).— **NET:** ASIZP 61246 (1, 170 TL), Nan-fang-ao; ASIZP 61247 (12, 142–168 TL), Nan-fang-ao; ASIZP 62331 (2, 126+–162+ TL), Fong-kang, 200 m; ASIZP 64236 (3, 110+–215 TL) and CAS 224885 (ex. ASIZP 64236) (2, 121+–161 TL), CP 234, 547 m; ASIZP 65549 (1, 160+ TL), CP 124, 1129–1165 m; ASIZP 70231 (2, 109–113 TL), Da-xi; ASIZP 70248 (9, 98–180 TL), Nan-fang-ao; ASIZP 70250 (1, 125 TL), Da-xi; ASIZP 70685 (1, 40 HL), Da-xi; ASIZP 70733 (1, 196 TL), Da-xi. **SWT:** ASIZP 62388 (1, 181 TL), Dong-gang, 300 m; ASIZP 66322 (1, 153 TL), Dong-gang. **SCS:** ASIZP 65521 (11, 100–142 TL) and ASIZP 65592 (18, 105–165 TL), CD 136, 998–1211 m; ASIZP 65588 (3, 140–155 TL), CD 141, 985–1110 m. **SET:** ASIZP 66104 (1, 65 HL, 285+ TL), CP 299, 799 m. **Other specimens:** BSKU 27695 (holotype) and six paratypes, BSKU 27123, 27191, 27660, 27696, 27861, 27865, Okinawa Trough. CAS 88668 (5, 51.6–58.7 HL, 233+–312+ TL), Philippines, off se coast Luzon; 14°50.46'N, 123°17.30'E, 760–770 m; *R/V Fishery Researcher I* sta. TFRI-Ph1–12–95, 27 Sep. 1995.

DISTINGUISHING FEATURES.— 1D II,10–12; P i19–i23; V 9–10; total GR-I (lateral/mesial) 10–13/15–17 total, (lateral/mesial) GR-II 14–17/(13)15–17; scale rows below midbase 1D 5.5–7.5, below 2D 7–8.5; lateral line scales over distance equal to predorsal length 36–43. Snout length 25–32% HL; preoral length 11–15%; internasal 18–23%; interorbital 21–27%; orbit 26–34%; postorbital 42–48%; orbit to preopercle (38) 41–44%; suborbital 11–14%; upper jaw (39) 42–47%; barbel (16) 19–26%; outer gill slit 22–28%; 1D-2D interspace 45–62%. Body moderately deep and compressed; snout low, blunt in adults, somewhat more pointed and protruding in young; suborbital area gently rounded. Body scales covered with small, slender, needle-like spinules in wide

chevron-like rows; an area of spinuleless scales along and behind 1D base. Color in alcohol overall dark, with faint silvery reflections along sides of head and trunk; bluish-black over abdomen and chest; gill cover and gill membranes mostly black; mouth and gill cavities pale, but dark in gullet; black margins on suborbital shelf, leading edge of snout, suparnarial ridges, and a V-shaped stripe joined at apex to black nape stripe before 1D; 1D black except distal third or less white, base dusky to pale; V black, P dusky but base black with bulk of lateral face of base silvery, A dark dusky overall but with narrow black distal margin anteriorly. Lips, mouth, jaws, and gill cavity as in others of genus. Attains about 33 cm TL.

DISTRIBUTION.— From s. Japan to sw. Taiwan (SCS) in 400–1211 m.

REMARKS.— Among the Taiwanese grenadiers, *V. rhipidodorsalis* is most similar to *V. nigrodorsalis*, but that species has 8 or 9 V rays (cf. 9 or 10), overall paler coloration; paler, more silvery sides; slightly sharper, more protruding snout; generally narrower black streak on 1D; and shorter upper jaw (37–41% HL). In its overall dark color and V count of 9–10, it resembles *V. macroptera*, but that species has a smooth 1D spinous ray and differences in dentition. Another species with a black streak across the 1D is *V. longibarbata*, but that species has slightly lower average number of V rays (8–9), much longer barbel (28–39% HL cf. 19–26%), slightly longer preoral length (16–17% cf. 11–15%), and somewhat fewer scale rows below 2D (5.0–6.5 cf. 7.0–8.5).

Ventrifossa saikaiensis Okamura, 1984

Ventrifossa saikaiensis Okamura in Okamura and Kitajima, 1984:209 (holotype, BSKU 28004; Okinawa Trough, 28°50.0'N, 127°14.0'E, 700–740 m; 11 paratypes, Okinawa Trough).— Chiou et al., 2004b: 48–49, fig. 23 (19 spec.; Taiwan [NET]).

Ventrifossa divergens (not of Gilbert and Hubbs, 1920): Chiou et al., 2004b:46, fig.19 (2 spec.; Da-xi, Taiwan [NET]).

MATERIAL EXAMINED (58 Taiwan spec.).— **NET:** ASIZP 61248 (1, 250 TL), Da-xi; ASIZP 61249 (14, 102–168 TL), Da-xi; ASIZP 61307 (1, 224 TL), Da-xi; ASIZP 61310 (1, 182 TL), Da-xi; ASIZP 64094 (1, 53 HL, 260+ TL), CP 235, 764 m; ASIZP 63271 (1, 144 TL), Da-xi; ASIZP 64094 (1, 260+ TL), CP 235, 764 m; ASIZP 65608 (1, 145+ TL), CP 120, 520 m; ASIZP 65602 (1, 295+ TL), CD 138 m; ASIZP 70223 (1, 60 HL), Da-xi; ASIZP 70225 (2, 270+–395 TL), Da-xi; ASIZP 70730 (1, 170 TL), Da-xi. **SWT:** ASIZP 61242 (1, 272 TL), Dong-gang; ASIZP 61309 (1, 220 TL), Dong-gang; ASIZP 64119 (1, 278+ TL) and ASIZP 64253 (1, 200+ TL), CD 193, 821 m; ASIZP 65601 (2, 285 TL) and CAS 224887 (ex. ASIZP 65601, 1, 299 TL), CD 139, 718–852 m; ASIZP 65608 (1, 145+ TL), CP 120, 520–640 m; ASIZP 65616 (1, 185 TL), CD 138, 441 m; ASIZP 70273 (1, 295 TL), CD 138, 441 m; ASIZP 71146 (1, 267 TL), CD 271, 700–800 m. **SCS:** ASIZP 64562 (1, 275 TL) and ASIZP 65562 (1, 275 TL), CD 140, 280–452 m; ASIZP 65522 (18, 90–185 TL), CD 136, 998–1211 m; ASIZP 61242 (1, 272 TL), Dong-gang. **Other specimens** (all from Okinawa Trough, East China Sea): BSKU 28004 (holotype, 305+ TL); BSKU 27576 (paratype, 285+ TL); BSKU 28005–28008 (4, 180+–290 TL).

DISTINGUISHING FEATURES.— 1D II,9–11; P i18–i22; V 8–9; total GR-I (lateral/mesial) 12–16 / 16–18, GR-II 15–18 / 15–18; scale rows below midbase 1D 5.5–7.0, below 2D 6.0–7.5; lateral line scales over distance equal to predorsal length 33–44. Snout length 28–31% HL; preoral length 14–19%; internasal 21–26%; interorbital 27–32%; orbit 27–32%; postorbital 44–48%; orbit to preopercle 43–46%; suborbital 14–16%; upper jaw 45–50%; barbel 27–35%; outer gill slit 27–30%; 1D–2D interspace 43–68%. Body and head moderately deep and compressed; snout low, rather blunt and protruding little beyond large mouth; barbel long, slender. Body scales densely covered with slender, reclined, needle-like spinules in wide chevron-like rows; no spinuleless scales around 1D base. Color in alcohol medium brownish, lacking silvery reflections; blackish over gill cover;

bluish-black over abdomen and chest; gill and gular membranes black; mouth and gill cavities pale, but dark in gullet; margins on suborbital shelf and leading edge of snout faintly blackish or not distinguished; barbel pale, but base dark; 1D uniformly dusky; V blackish; P and A dark dusky, but base of P black along distal margin. Coloration of lips, mouth, jaws, teeth, and gill cavities as in others of genus. Attains more than 31 cm TL.

DISTRIBUTION.— Known only from the Okinawa Trough (in East Sea), Taiwan (NET, SWT), and the South China Sea in 280–1211 m.

REMARKS.— Chiou et al. (2004b:46, fig.19) recorded two specimens (ASIZP 61309 and 61310) as *V. divergens*, but we re-identified them as *V. saikaiensis*. Among the Taiwan grenadiers, *V. saikaiensis* is most similar to *V. divergens* in having a uniformly dusky 1D, but it is easily distinguished from that species (and all other Taiwan members of *Ventrifossa*) in having a uniformly brownish overall coloration, with little or no silvery reflections on the sides, and dark brown scale pockets. In these color features and in its general appearance, the species resembles certain members of the genus *Nezumia*, especially *N. atlantica* (Parr, 1946) and *N. africana* (Iwamoto, 1970). However, the dentition, squamation, luminescent organ, gill rakers and arches, and other features clearly support its position within *Ventrifossa*.

Ventrifossa sazonomi Iwamoto and Williams, 1999

Figure 30.

Ventrifossa sazonomi Iwamoto and Williams, 1999:231, fig. 56 (holotype: CAS 13564, South China Sea, off Vietnam, 15°48'N, 109°47'E, depth 479 meters; 15 paratypes, n. and w. Australia).

MATERIAL EXAMINED.— SWT: BSKU 98976 (1, 38.5 mm HL, 202+ mm TL), Dong-gang Fish Market, ca. 200–300 m depth, bottom trawl, coll. by H.-C. Ho, 16 Nov. 2007.

DISTINGUISHING FEATURES.— 1D II,10; P i21–22; V 9; GR-I (outer/inner) 13/17; GR-II (outer/inner) 18/17. Snout 27% HL; preoral 10% HL; interorbital 25% HL; orbit 33% HL; suborbital 11% HL; orbit to preopercle 45% HL; upper jaw 47% HL; barbel 21% HL; outer gill slit 27% HL. Head and body moderately compressed; snout relatively short, barely protruding beyond upper jaw; suborbital shelf somewhat constricted anteriorly; chin barbel fairly developed; pectoral fin rather short, 1.7 in HL. Branchiostegal membranes narrowly united over isthmus; gill opening extending forward to below hind 1/3 of orbit. Periproct situated just behind V insertions, occupying about 1/3 of V–A interspace; dermal window of light organ small, reaching on a line passing through outer V bases. Premaxillary teeth in broad tapered band; outer series distinctly enlarged; dentary teeth aligned in irregular 2 rows. Spinules on body scales needle-like, arranged in quincunx order; those on scales along 2D base prominently enlarged. No modified scutes on snout. 1D smooth along its leading edge. Color in preservative light brown overall, but dark over ventral parts of head and abdomen; prominent blackish streaks along leading edge of snout, upper suborbital shelf, and



FIGURE 30. *Ventrifossa sazonomi* Iwamoto and Williams, 1999. BSKU 98976, 202+ mm TL, preserved.

median nasal ridge; lips and chin barbel pale; oral cavity immaculate; 1D darker proximally, paler distally; V blackish; other fins dusky overall. Attains at least 34 cm TL.

DISTRIBUTION.— Known from the South China Sea off Vietnam and Taiwan, and northern coasts of Australia from Western Australia to Queensland, in about 200–610 m.

REMARKS.— This species is readily distinguished from other Taiwanese congeners except *V. macroptera* in having a smooth leading edge of 1D. It further differs from *V. macroptera* in having enlarged spinules on scales along 2D base. The Taiwanese specimen is the shallowest captures (previously known only below 420 m) and the northernmost record of the species.

Family Macrouroididae

DISTINGUISHING FEATURES.— Head huge, rounded, with consistency of water-filled balloon; eyes tiny, diameter about 10 times into head length, placed forward of upper jaws; dorsal fin single, low; A long low; V absent (*Macrouroides*) or tiny with five short rays (*Squalogadus*); chin barbel absent; outer GR-I somewhat lathlike; first (outer) gill slit not restricted dorsally and ventrally by opercular membrane.

REMARKS.— Two genera, each with one widespread species, found in most tropical and temperate oceans.

Genus *Squalogadus* Gilbert and Hubbs, 1916

DISTINGUISHING FEATURES.—V present but tiny, five rays, none prolonged; other features as for family.

Squalogadus modificatus Gilbert and Hubbs, 1916

Figure 31.

Squalogadus modificatus Gilbert and Hubbs, 1916:156 (Bungo Channel, 32°32'N, 132°25'E, off Kyushu, Japan, *Albatross* sta. 4956, 720 fm [1317 m]; holotype USNM 76864, paratypes SU 22928).— Marshall, 1973:517–518.— Okamura, 1970:16–18, pl. IX (Sagami Bay and off Choshi, Japan).— Shiobara, 1982:143–146, figs. 1–3 (2 spec., 261–397 mm TL; Suruga Bay, Japan).— Sawada *in* Amaoka et al., 1983:105, 192, fig. 57 (HUMZ 78126, 1 spec., off Miyagi, Tohoku district, 1110 m).— Okamura *in* Masuda et al., 1984:93.— Endo et al., 1994:332 (HUMZ 121632, 1 spec., Sea of Okhotsk off ne. Hokkaido, 1393 m; n. record).— Okamura and Amaoka, 1997:129 (photograph of living individual).— Shinohara et al., 1996:170 (7 spec., east-central Honshu, Japan; 967–4867 m).— Shinohara et al., 1997:290 (listed).— Shinohara et al., 2001:306 (1 spec., Tosa Bay, 765–823 m).— Amaoka, 2009:177, fig. 304 (photo of fresh specimen). See also Shao et al. (2008: table 1, 1 spec., SCS) first record for Taiwan.

Squalogadus intermedius Grey, 1959:330–333, fig. 53 (holotype USNM 185606, n. Gulf of Mexico, R/V *Oregon* sta 1426, 1098 m; 5 paratypes, FMNH 64489).

MATERIAL EXAMINED.— SCS: ASIZP 64070 (1, 330+ TL), CP 178, 1241 m.

DISTINGUISHING FEATURES.— As for genus.

DISTRIBUTION.— Widespread in tropical and southern temperate seas, but absent in e. Pacific. In nw. Pacific, known off Japan, from Hokkaido to Kyushu and Taiwan.

REMARKS.— A single specimen collected from SCS off sw. Taiwan in 1241 m represents the first record from Taiwan.



FIGURE 31. *Squalogadus modificatus* Gilbert and Hubbs, 1916. ASIZP 64070, 330+ mm TL, preserved.

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Appendix

TABLE 1. Collection data for station of research vessels and commercial trawls operating out of nine fishing ports. Abbreviations: CD—otter trawl station; OCP—ORE-type beam trawl station and CP—the French type beam trawl station.

Station/Location	Longitude and Latitude	Region	Date	Depth (m)
CP 119	122°01'E, 24°56'N	NET	7/31/01	123–140
CP 120	122°02'E, 24°51'N	NET	7/31/01	520–640
CP 124	122°17'E, 24°58'N	NET	8/1/01	1129–1165
CP 127	121°03'E, 22°08'N	SET	8/21/01	1263–1268
CP 130	120°07'E, 22°19'N	SCS	8/22/01	709–728
CD 133	120°08'E, 22°15'N	SCS	11/21/01	690–748
CD 134	120°06'E, 22°16'N	SCS	11/22/01	736–1040
CD 136	120°00'E, 22°07'N	SCS	11/22/01	998–1211
CD 137	120°25'E, 22°12'N	SWT	11/23/01	316–477
CD 138	120°20'E, 22°13'N	SWT	11/23/01	441
CD 139	120°14'E, 22°10'N	SWT	11/23/01	718–852
CD 140	120°22'E, 22°11'N	SWT	11/23/01	280–452
CD 141	119°59'E, 22°12'N	SCS	11/24/01	985–1110
CD 142	120°13'E, 22°21'N	SWT	11/24/01	227–335
CP 178	119°55'E, 22°25'N	SCS	8/25/02	1241
CD 191	118°22'E, 21°41'N	SCS	8/28/02	1621–1630
CD 192	120°01'E, 22°17'N	SWT	8/29/03	1305
CD 193	120°06'E, 22°22'N	SWT	8/29/02	821
CD 194	120°24'E, 22°11'N	SET	8/29/02	507
CP 195	122°03'E, 24°52'N	NET	9/11/02	570
CP 196	122°03'E, 24°51'N	NET	9/11/02	646–787
CP 197	122°17'E, 24°51'N	NET	9/11/02	1040–1141
CD 199	122°12'E, 24°25'N	ET	9/12/02	1134–1188
CD 203	120°28'E, 22°00'N	SCS	5/29/03	634–866
CD 209	122°11'E, 24°40'N	NET	5/30/03	508–522
CD 210	122°12'E, 24°28'N	ET	5/31/03	445–1185
CD 211	122°11'E, 24°40'N	NET	8/26/03	517–529
CD 214	122°12'E, 24°28'N	ET	8/27/03	488–1027
CP 214	122°13'E, 24°29'N	NET	8/27/03	488
CD 226	121°04'E, 22°18'N	SET	8/29/03	1174–1212
CD 228	121°01'E, 22°08'N	SET	8/30/03	1262–1290
CD 229	120°01'E, 22°13'N	SWT	8/30/03	880–1062
CD 230	120°03'E, 22°19'N	SWT	8/30/03	810–850
CD 233	120°19'E, 22°11'N	SWT	8/31/03	448–526
CP 234	122°31'E, 25°22'N	NET	7/22/04	547
CP 235	122°43'E, 25°23'N	NET	7/23/04	764

TABLE 1. Continued.

Station/Location	Longitude and Latitude	Region	Date	Depth (m)
CP 242	122°29'E, 25°08'N	NET	7/23/04	979
CP 247	122°02'E, 24°52'N	NET	8/28/04	480
CP 248	122°02'E, 24°51'N	NET	8/28/04	536
CP 250	122°04'E, 24°55'N	NET	8/28/04	220
CD 271	120°.8'E, 22°19'N	SWT	12/28/04	700–800
CP 299	122°03'E, 22°19'N	SET	8/11/05	799
OCP 301	120°06'E, 22°20'N	SET	8/11/05	687
OCP 302	120°06'E, 22°21'N	SET	8/11/05	695
OCP 303	120°15'E, 22°10'N	SWT	8/15/05	807
CD 307	118°14'E, 21°35'N	SCS	8/16/05	1591
CD 310	117°17'E, 21°35'N	SCS	8/17/05	364
CD 311	117°43'E, 21°40'N	SCS	8/17/05	516
OCP 312	117°43'E, 21°40'N	SCS	8/17/05	517
OCP 313	117°43'E, 21°40'N	SCS	8/17/05	513
CP 314	117°43'E, 21°40'N	SCS	8/17/05	506
CP 315	117°43'E, 21°40'N	SCS	8/17/05	509
CP 316	117°43'E, 21°40'N	SCS	8/17/05	514
OCP 317	117°43'E, 21°40'N	SCS	8/17/05	515
CD 320	117°27'E, 20°50'N	SCS	8/17/05	731
CD 321	117°33'E, 20°43'N	SCS	8/19/05	954
CD 322	117°39'E, 20°44'N	SCS	8/19/05	1098
CD 324	117°45'E, 20°40'N	SCS	8/20/05	1293
CD 325	118°03'E, 20°40'N	SCS	8/20/05	1982
CP 338	120°20'E, 22°10'N	SCS	3/7/06	569
CP 339	120°15'E, 22°10'N	SCS	3/7/06	846
CP 347	120°13'E, 22°25'N	SCS	3/9/06	305
CP 348	120°12'E, 22°22'N	SCS	3/9/06	395
CP 350	121°08'E, 22°21'N	SET	6/2/06	1148
CP 353	121°04'E, 22°15'N	SET	6/2/06	1205
CP 366	121°10'E, 22°01'N	SET	8/24/06	1302
Da-xi	121°54'E, 24°56'N	NET		ca. 100–650
Diao-yu-tai	123°30'E, 25°43'N	NET		ca. 100–400
Hsiao-liou-chiou	120°22'E, 22°20'N	SWT		ca. 100–400
Fong-kang	120°41'E, 22°11'N	SWT		ca. 100–200
Jin-shan	121°55'E, 25°33'N	NT		ca. 100
Lyu-dao	121°29'E, 22°38'N	ET		ca. 400
Nan-fang-ao	121°52'E, 24°35'N	NET		ca. 100–600
Dong-gang	120°26'E, 22°27'N	SWT		ca. 100–400
Tong-sa Islands	116°51'E, 20°41'N	SCS		ca. 100–600